"Nickel, Jon"
<JNickel@ASARCO.com>
10/05/2006 07:27 AM

To Linda Jacobson/ENF/R8/USEPA/US@EPA, "Denise A. Kirkpatrick (E-mail)" <dkirkpatrick@mt.gov>
cc "Miller, Robert" <RoMiller@asarco.com>, "Aldrich, Tom" <TAldrich@ASARCO.com>
bcc
Subject FW: ASARCO Slurry Wall project in East Helena, MT

Linda and Denise - Attached please find the Work Plan, figures, and appendices that outline the design and construction of the slurry wall at the former acid plant sediment drying area. Please let me know if you wish me to send you a hard copy of the Work Plan. I request a rapid review and approval of the Work Plan so that our aggressive construction schedule can be met. Pending EPA/MDEQ approval of the attached work plan, Asarco is poised to begin the construction of the slurry wall as earlier as the week of October 16. As I have discussed with you in the past, we are hopeful to promptly begin the project so that we can avoid inclement weather and complete the project this year. However, freezing temperatures may delay the start of the project until next spring. If you should have any questions, please do not hesitate to contact me. I will contact both of you early next week to discuss how your review is proceeding.

Jon Nickel
Asarco LLC
East Helena Plant

-----Original Message-----
From: Coombe, Elaine [mailto:elaine.coombe@shawgrp.com]
Sent: Wednesday, October 04, 2006 3:46 PM
To: RoMiller@asarco.com
Cc: JNickel@asarco.com; Wetzsteon, Brian
Subject: ASARCO Slurry Wall project in East Helena, MT

Bob,
Per your request, the attached files contain the Work Plan, associated figures, and the Appendix A: Quality Control (QC) Plan for the Former Acid Plant Sediment Drying Area Slurry Wall project in East Helena, MT. For ease of review and forwarding the plans to the regulators, the Work Plan, Figures 1 through 5, and Appendix A: QC Plan are sent as separate files.

Work Plan and Figures 2 through 5
<<Work Plan.pdf>> <<Fig 1 General Site Plan.pdf>> <<Fig 2 Side-A-Profile.pdf>> <<Fig 3 Side-B-Profile.pdf>> <<Fig 4 Side-C-Profile.pdf>> <<Fig 5 Side-D-Profile.pdf>>

Work Plan - Appendix A: QC Plan
<<Appendix A - QC Plan.pdf>>

Please note that Shaw's Site Specific Health and Safety Plan will be sent in a separate e-mail. Please call me or Russell Morgan if you have any questions.

Thank you.

Elaine R. Coombe, P.E.
Senior Engineer
Shaw Environmental & Infrastructure, Inc.

9201 East Dry Creek Road
Centennial, CO 80112
(303) 741-7550 direct
(303) 793-5222 fax
elaine.coombe@shawgrp.com
www.shawgrp.com

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* Work Plan.pdf

Fig 1 General Site Plan.pdf

Fig 2 Side-A-Profile.pdf

Fig 3 Side-B-Profile.pdf

Fig 4 Side-C-Profile.pdf

Fig 5 Side-D-Profile.pdf

Appendix A - QC Plan.pdf

Work Plan

Former Acid Plant Sediment Drying Area Slurry Wall

ASARCO Smelter Facility East Helena, MT

Shaw E&I Project No.123157

October 2006

Shaw™ Shaw E & I

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ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm/sec	centimeter per second
EPA	Environmental Protection Agency
FADL	Field Activity Daily Log
HSP	Health and Safety Plan
MDEQ	Montana Department of Environmental Quality
QC	quality control
RCRA	Resource Conservation Recovery Act
SB	soil-bentonite
SBC	soil-bentonite-cement
Shaw	Shaw Environmental & Infrastructure, Inc.

TECHNICAL WORK PLAN
SLURRY WALL AT THE FORMER ACID PLANT SEDIMENT DRYING AREA

1.0 INTRODUCTION

This Work Plan details the actions required for the design and construction of a slurry wall at the ASARCO smelter facility located in East Helena, Montana. Shaw Environmental & Infrastructure, Inc. (Shaw) prepared this document and will perform the work described herein.

The goal of this project assignment is to design and construct a slurry wall to encompass the former acid plant sediment drying area. Subsurface sediments and groundwater underlying former sediment drying area encompassed by the wall has been identified as a primary source of arsenic in down-gradient groundwater. The dimensions of the slurry wall will be approximately 800 feet in length, 32 to 37 feet in depth, and 3 feet thick. Figure 1 shows the general plan and layout of the slurry wall and Figures 2 through 5 show the slurry wall profile for each of the four sides. The slurry mixture will consist of a soil-bentonite (SB) backfill mixture.

1.1 PROJECT OBJECTIVES

The objectives of this work plan are as follows:

- Design the slurry wall;
- Construct the slurry wall at the former acid plant sediment drying area;
- Restore the site; and
- Prepare a final construction report.

1.2 SITE DESCRIPTION

The ASARCO smelter facility includes a lead smelter that operated from 1888 until 2001, the town of East Helena, several residential subdivisions, and surrounding rural agricultural lands, covering approximately 8.4 square miles near East Helena, Montana. ASARCO suspended operations at the plant on April 4, 2001. Public access to the smelter is restricted. The ASARCO smelter facility is being addressed by ASARCO in cooperation with the Environmental Protection Agency (EPA) under both the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Superfund program and as subject to the provisions of the Resource Conservation and Recovery Act (RCRA).

The slurry wall will be constructed as a continuous wall of SB materials. The intended location of the slurry wall is at the former acid plant sediment drying area located on the south side of the ASARCO facility (see Figure 1).

In September 2006 ASARCO drilled four soil borings at the proposed location of the slurry wall for the purpose of determining the depth of the slurry wall. The drilling showed an organic clay layer at about 20 feet below ground surface was too thin and inconsistent to serve as a good impermeable layer to key into. As a result, the wall will be advanced to the thicker and

consistent ash clay unit that underlies the saturated alluvial sand and gravel in the area. ASARCO provided Shaw with a topographic survey of the boring area and the four (4) corners for alignment of the slurry wall.

1.3 SCOPE OF WORK

In conjunction with this Work Plan, a Quality Control (QC) Plan (see Appendix A of this Work Plan), and a Shaw Site Specific Health and Safety Plan (HSP) will be developed and implemented for this project.

Shaw will perform the following activities:

1. Develop and implement the activities described in the Work Plan and the QC Plan.
2. Apply the appropriate safety precautions and procedures prior to the implementation of any field work; safety concerns will be continually addressed, resolved and monitored for compliance throughout the entire project.
3. Mobilization of manpower and equipment required to design and construct the slurry wall.
4. Prepare the site for construction of the slurry wall.
5. Construct the slurry wall per the design drawings and specifications as approved by ASARCO, EPA, and Montana Department of Environmental Quality (MDEQ).
6. Backfill the trench with slurry mixture containing SB.
7. Restore the site after construction has been completed per Section 4.12 Demobilization and Site Restoration.
8. Demobilize manpower and equipment from the work site.

1.4 PROJECT ORGANIZATION

Figure 6, Project Organization Chart depicts the key project organizational structure and personnel associated with this slurry wall construction project. Key ASARCO, Shaw, and Shaw subcontractor personnel, their telephone numbers, fax numbers, e-mail addresses and project contacts are listed in Table 1.

1.5 PROJECT SCHEDULE

The current project schedule estimates that general field work activities will be completed in a period of three to four weeks. Tentatively, mobilization will begin during the second week of October 2006. The following items briefly describe the schedule on a week-by-week basis. ASARCO, subcontractors (e.g., Geo-Solutions), and project participants will be informed of specific dates and updates for scheduled field activities as available.

- Week 1 – Mobilize personnel and equipment, survey site, prepare site for construction
- Week 2 – Construct the slurry wall (work will continue into part of Week 3)
- Week 3 – Site restoration, clean up site, and demobilize equipment and personnel (work may continue into part of Week 4)

2.0 DESIGN APPROACH

The major factors that determine the design specifications for a slurry wall are the types of contaminants present and their associated concentrations, the compatibility of the slurry materials with existing groundwater, and the anticipated permeability of the slurry wall materials. The initial bench scale laboratory studies were performed in September 2006 to design the slurry wall backfill mixture. Shaw, in conjunction with Geo-Solutions, Inc., performed the bench scale tests utilizing field materials provided by ASARCO. These field materials included groundwater and soil boring soils from the former Acid Plant Sediment Drying area and borrow material soils from an area south of the ASARCO facility near the proposed Corrective Action Management Unit (CAMU) Phase 2 cell.

Two separate bench scale laboratory studies were initiated utilizing SB and SBC mixes. If the compatibility tests proved that the bentonite was compatible with groundwater then a SB slurry mixture would be formulated. The bench scale laboratory study was performed on the SBC mix in case the compatibility tests proved that bentonite was not compatible with groundwater. The following activities were conducted for the studies:

- The initial bench scale laboratory study included:
  - "Index" tests to assess the gross compatibility of commercial clays with site groundwater. The Index tests included (1) Chemical Desiccation, (2) Sedimentation /Flocculation, and (3) Modified Filter Press with Groundwater
  - Two additional Index tests were performed to assess the gross compatibility with SBC and groundwater. These Index tests included (1) the Cement Pan Test, and (2) the Slate Test.
  - Based on the Index Tests, a number of mixtures (typically three to five) were formulated and tested to determine the optimum mixture for low permeability of water based on the site samples provided.

The summary of the bench scales results are included in Appendix B of the Work Plan.

2.1 DESIGN-PHASE INVESTIGATION

ASARCO conducted a site investigation in August 2006 to more fully characterize the soil conditions of the proposed slurry wall location. Four soil borings were drilled in the former acid plant sediment drying area to determine the depth to clay layer; type, composition and limits of various soils within the boring columns; and potential subsurface obstructions. Copies of the soil borings are located in Appendix C. The slurry wall alignment will be based on the placement of four corner stakes by ASARCO with modifications by ASARCO as required to avoid existing underground utilities (pipelines).

2.2 SLURRY BACKFILL MIX DESIGN

The SB slurry backfill mixture was based on the initial bench scale laboratory studies. A slurry backfill mix was designed based on a maximum permeability rate of 1 x 10^{-7} centimeter per

second (cm/sec) (anticipated maximum permeability rate based on previous slurry wall designs) as demonstrated by the Index and Permeability tests.

The long-term compatibility/permeability tests of the SB slurry backfill mixture will be performed utilizing site groundwater. This long-term compatibility test will run concurrently with the construction of the slurry wall to more closely simulate the expected permeability of the barrier wall and the chemical compatibility of the materials at the site.

Shaw anticipates that the Index and Permeability tests will demonstrate that a slurry backfill mix will require at or about six (6) percent bentonite content to meet the maximum permeability rate.

2.3 TRENCH DESIGN

Shaw utilized the information provided by ASARCO of the soil borings to determine the depth of trench excavation. The trench will be excavated a minimum of two (2) feet into the clay contact surface to depths ranging from a minimum of 32 to 37 feet below ground surface (bgs). The proposed slurry wall trench layout is shown on Figure 1 and profiles for each of the four sides are shown on Figures 2 through 5.

Various construction methods were evaluated for excavating the trench and placing the slurry backfill mixture. Due to the required depth for the slurry wall, density of the soils, and proximity of utilities, excavation with a long-stick excavator, which has a maximum depth capability of 50-foot, was considered the best construction methodology. The minimum width of a trench excavated by this method is 3 feet, but it anticipated that the median trench width will be three feet with potential localized trench widths ranging from 3 to 5 feet due to sidewall sloughing.

3.0 CONSTRUCTION SPECIFICATIONS

A set of construction specifications are included in Appendix D of this Work Plan. A brief summary of some of the items is presented in the following sections.

3.1 SITE PREPARATION

The following items will be completed prior to start of slurry wall excavation:

- Run-on/runoff berms will be constructed utilizing site soils or soil from the ASARCO onsite borrow source. The soil berm will be constructed around the slurry wall construction area as shown in Figure 1.
- Silt fence will be placed next to the berm on the east side of the work site, that is, adjacent to the Lower Lake as shown on Figure 1.
- Temporary construction fence (i.e., orange safety fence) will be placed on the north and west sides of the work area as appropriate.
- Temporarily remove portions of the fence (southeastern part of the site between the Lower and Upper Lakes), if necessary, to allow for clearance of excavation equipment.

An area south of the ASARCO facility near the proposed CAMU Phase 2 cell has been identified as the onsite borrow area by ASARCO. Soil will be excavated from the CAMU area and transported via trucks to the slurry wall construction area. The onsite borrow soil will be used for berm construction, if needed, construction of a work platform, and for the slurry backfill mix.

3.2 EXCAVATED SOILS

Excavated materials will be segregated into two separate piles; the first pile will contain soil that can be used in the slurry backfill mix and the second pile will contain rock and unsuitable material (spoils) that cannot be used in the slurry backfill mix. The excavated rock and other unsuitable materials will be stockpiled onsite within the "bermed" area in the general vicinity of the work area inside and/or just outside the slurry wall foot print due to the limited work area. Excavated rock and unsuitable materials stockpiled outside the slurry wall alignment will be placed on a lined containment berm. A containment berm or other structure will be constructed prior to "remote" stockpiling of excavated rock or unsuitable soils (spoils). The containment berm will be lined with six (6) mil visqueen to create a "lined' bottom. Spoils will be placed within the containment berm on top of the liner. As necessary due to inclement weather (rain, snow, high winds), the stockpile will be cover with six (6) mil visqueen and anchored in place with sand bags. Upon completion of the slurry wall all "remote" stockpiles of rocks and spoils will be covered with visqueen and anchored with sand bags pending capping of the slurry wall area by the capping contractor.

3.3 SLURRY BACKFILL MIX

The specification for the slurry backfill mix is included in Appendix D of this document. Guidelines for placement procedures and quality assurance/quality control testing have also been provided. Some slurry backfill mix requirement values listed in Appendix D will be changed based on the selected slurry design mix.

The slurry mixture will be mixed on site using the following criteria and components:

- Production/mix water will be obtained from the Upper Lake via ASARCO's existing water supply system (pump setup).
- Onsite borrow soil will be utilized in the slurry backfill mix to compensate for anticipated lack of fines in the in-situ acid plant materials required for the slurry backfill mix.
- Shaw assumed that 50 percent of the excavated material will be unsuitable for the slurry backfill mix.
- An area near the proposed CAMU Phase 2 Cell has been identified by ASARCO as the onsite clean borrow source.
- The slurry backfill mixture design specifies percentages of bentonite, backfill material and/or cement, if required, to be utilized in the slurry backfill mix as determined by calculating the volume and weight of the insitu soils in a given length of trench and from the mix design ratios calculating the bentonite required and "adding" the necessary number of "bulk bags" of bentonite to that given length of trench.
- Quality control of the slurry backfill mix will document that the correct percentage of bentonite, backfill material and cement, if required, is utilized in the slurry backfill mix. During the backfilling of the trench, backfill slurry mix will be collected from the

excavator's bucket to test for quality control by documenting the backfill slump and unit weight. The construction quality control plan is located in Appendix A of this Work Plan.

- A mixing circuit for the slurry will be established within or adjacent to the work area.

4.0 SLURRY WALL CONSTRUCTION ACTIVITIES

The following subsections outline the activities anticipated for the construction of the slurry wall at the former acid plant sediment drying area. General activities include (1) site preparation, (2) excavation of the trench, (3) installation of the slurry backfill mixture, and (4) site restoration.

Health and safety meetings will be held prior to each work day to ensure worker familiarity with current site conditions. Based upon Shaw's HSP, all work will be conducted using the appropriate personal protective equipment.

4.1 PRE-CONSTRUCTION SITE ACTIVITIES

4.1.1 Site Survey

Prior to the construction of the slurry wall, Shaw will conduct a site survey (inspection). The site survey will be attended by Shaw, Shaw subcontractor (e.g., Geo-Solutions), ASARCO, EPA, and MDEQ.

The objectives of the site survey will be to complete the following:

- Gain familiarity with existing site conditions and obstacles;
- Review the content of the ASARCO's *East Helena Plant Safety Orientation for Contractors* (ASARCO, 1994);
- Resolve any issues regarding Shaw access to ASARCO facilities during slurry wall construction activities;
- Identify and verify (with ASARCO) the location of existing utilities and mark their locations for avoidance with the slurry wall alignment ;
- Identify the location of overhead and underground electric lines to be locked/tagged out (if applicable);
- Identify the location of potable water supply lines (if applicable);
- Plan field activities in a manner that protects existing utilities, structures, surface features, service operations, and existing monitor wells as directed by ASARCO;
- Plan field activities in a manner that will protect the general site environment from soil stockpiling, heavy machinery, dust, etc.;
- Identify the location of the onsite borrow area (e.g., CAMU) and arrange logistics to move onsite borrow soil to the slurry wall construction site.
- Identify the general location for the slurry plant and a water source for slurry;
- Identify the location of areas for liquid and soil stockpiles and equipment storage;
- Identify the locations where stormwater run-off control measures will be required; and

- Identify the location of staging area(s) for dump truck loading/unloading and material storage

4.1.2 Permitting and Coordination

The following permits, coordination, and documentation will be acquired and/or completed:

- Compliance with applicable requirements of the Montana Department of Environmental Air Quality Resources Management Bureau for activities that may result in air emissions; and
- Activities that affect utilities (water, electrical, steam, sewerage, etc.) will be coordinated through ASARCO.

4.1.3 Procure Subcontractors

The following subcontractor needs are anticipated and will be secured prior to the commencement of activities:

- Geo-Solutions, Inc. to provide the slurry and specialty equipment
- Installation equipment and related machinery (i.e., crane to assemble long stick)
- Mobilization/Demobilization of frac tank for liquid storage
- Excavated soil (from onsite borrow area) transporters
- Surveyors

4.1.4 Mobilization for Construction Activities

Mobilization of personnel and construction equipment will occur upon authorization by ASARCO. Shaw personnel will be utilized for the construction of the slurry wall. The project will be managed from Shaw's Portland, Oregon office. The equipment mobilized to the work site will include but not be limited to:

- Front-end Loader(s)
- Long-stick excavator
- Hydraulic excavator
- Dozer
- Compactor
- Material screen
- Crane
- Dump trucks
- Equipment for the mixing and delivery of slurry (mix plant) into the trench
- Equipment for the delivery of slurry material into the trench
- Frac tank(s)

4.2 REVIEW AVAILABLE INFORMATION

Shaw will review available information obtained from ASARCO and local utility providers regarding locations of existing utilities including above and/or below ground piping networks (sanitary sewer, stormwater, and potable water lines), electrical power lines, telephone and fiber optic lines, natural gas pipelines, etc., as applicable. Shaw will also review available historical information obtained from ASARCO, which may include pertinent data related to the work site. The purpose of this investigation (exercise) will be to assess and prepare for potential safety concerns that may arise during the installation of the slurry wall.

4.3 SITE ACCESS AND SECURITY

Shaw and Shaw's subcontractors will conform to ASARCO rules for on-site contractors that include safety, security, and notification procedures and requirements. The rules and regulations will be discussed at the pre-installation meeting and at project status meetings that will be conducted throughout the duration of the project.

4.3.1 Security Procedures

The Shaw Construction Site Manager will control installation area access during this project and will be responsible for directing installation activities. The normal work hours will be from 7:00 a.m. to 5:00 p.m., Monday through Saturday. Longer hours and workweeks may be necessary depending on the life cycle of the slurry, and if necessary, will be discussed with ASARCO. The City of East Helena will provide emergency services. The 911 emergency telephone number is in effect and will be utilized in the event of an emergency.

During the construction of the slurry wall, orange safety fencing, and/or warning signs will be utilized to restrict unauthorized entry into active work areas. Sufficient prior notification regarding these activities will be given to ASARCO, as appropriate.

4.4 EQUIPMENT SET-UP AREAS

Suitable areas will be selected within the work area where heavy equipment (such as media mixers, excavators, dump trucks, and so on) may be staged during the site preparation and construction activities. Equipment set-up areas will be selected based upon accessibility to a targeted work area. The selected set-up area will not impede access to or traffic flow around specific targeted work areas.

4.5 INSPECTION AND DECONTAMINATION OF HEAVY EQUIPMENT

Shaw will inspect transport vehicles (dump trucks) for structural integrity and regulatory compliance, as appropriate. Structural integrity concerns may include holes or cracks in floors and/or walls, liners and/or tarps, previous contamination, and excessive oxidation (rusting). Dump trucks used for this project will have covers that do not require workers to place or remove the cover by hand, to minimize contact with the excavated soil.

Other heavy equipment such as slurry mixers, excavators, and bulldozers arriving at the slurry wall work site for the first time will have already been decontaminated prior to their arrival.

On-site decontamination of heavy equipment will be implemented at the decontamination pad constructed at the slurry wall site. The run-off rinse water will be collected and mixed onsite inside the slurry wall footprint in the middle of the former acid plant sediment drying area and mixed with available "dryer" soils.

Gross decontamination of equipment will be performed whenever leaving the designated work area. Gross decontamination will focus on minimizing the spread of excavated soil as a result of equipment movement and transport. This decontamination process shall use dry methods (brooms, wipes, shovels, etc.) within the work zone in order to remove large, easy dislodged deposits of soil and/or other contaminated media prior to exiting the work zone.

4.6 WASTE MANAGEMENT

The waste stream anticipated during the course of the slurry wall construction is excavated soils (spoils) and excess slurry mixture. During slurry wall construction, piles(s) of excavated spoils unsuitable for backfill slurry mix will remain onsite where they are stockpiled. It is anticipated that approximately half of the excavated soil or approximately 2,500 cubic yards of spoils will be unsuitable for the backfill slurry mix and will be stockpile onsite. Excavated spoils will be stockpiled away from the slurry trench at anticipated locations shown on Figure 1. Excess slurry will be placed onsite inside the slurry wall footprint in the former acid plant sediment drying area and/or mixed with available "dryer" soils. Although not part of this slurry wall construction work plan, excavated spoil stockpiles will be incorporated under the acid plant sediment drying area cap as described in the Groundwater Corrective Action Plan - 2006 (Asarco, August 30, 2006) after wall construction is completed or stored in approved temporary storage locations.

A decontamination pad located at the slurry wall work site will be used for decontamination activities. The run-off rinse water will be collected and mixed onsite inside the slurry wall footprint in the former acid plant sediment drying area and/or mixed with available "dryer" soils.

4.7 CONTROL OF FUGITIVE EMISSIONS

Fugitive emission control measures will be implemented beginning with the mobilization of equipment, materials, and manpower, and will continue during all phases of fieldwork. Air emissions from dust in the air will be controlled by spraying the surface of the area to be excavated with water or with a dust-suppressing agent, if required.

In general, slurry trenching creates only a minor potential for dusting because of the use of liquid slurry, which provides an engineering control. If conditions require specialized controls, Shaw will re-evaluate site conditions and propose corrective actions.

4.8 EXCAVATION PROCEDURES

The objective of this task is to excavate soil from the trench alignment where the slurry wall will be constructed. All excavation work will be performed in accordance with the HSP and applicable federal, state, and local regulations. In order to comply with OSHA regulations concerning confined-space entry, Shaw will not allow any personnel to enter any excavation that is greater than 4 feet bgs. During most of the work, the trench will be filled with slurry, so that entry will not, in general, be possible. The trench will be supported by the slurry and will not require shoring or dewatering. The slurry acts to stabilize the walls of the trench preventing their collapse during excavation.

Shaw and Shaw's subcontractors will take the necessary precautions to protect all underground utilities, survey benchmarks, and control points as directed by ASARCO. Excavation of the slurry wall trench will be performed primarily using a long stick excavator working through and under the slurry.

The slurry trench will extend to an approximate depth of 32 to 37 feet bgs, while groundwater may be encountered at a depth of approximately 5 to 7 feet bgs. It will not be possible to observe the groundwater or trench bottom during the excavation due to the presence of the groundwater and the slurry backfill mix in the trench. De-watering equipment will not be necessary during the installation of the slurry wall.

4.8.1 Trench Construction

The trench will be backfilled with the SB slurry backfill mixture in order to keep it from collapsing. After the excavation of a portion of the slurry trench, the slurry backfill mixture, will be placed into the trench displacing the slurry into subsequent excavations.

Shaw will provide sufficient numbers and types of excavating equipment to complete the slurry wall trench to the final depth and complete the project within the given schedule. The equipment will be in good working condition with no hydraulic leaks. This heavy equipment will have been decontaminated prior to mobilization to the work site. The plant for mixing the slurry will include the necessary equipment.

Shaw will maintain the stability of the trench excavation. This will be accomplished through the use of the slurry and by controlling the surcharge (weight) associated from the following live and dead loads, including excavation and backfill equipment, soil stockpiles and backfill stockpiles. The amount and quality of the slurry in the trench will be maintained at a level sufficient to maintain trench stability, but generally the trench will be full of slurry at all times.

Shaw will have sufficient personnel and equipment ready during construction and on-call during nights and weekends. The quality of the slurry will be maintained at all times until the SB backfill mixture is in place.

The following tolerances will apply to the slurry wall trench dimensions and installation. The slurry wall trench will be essentially vertical. The working platform and/or excavating

equipment will be leveled to be plumb to the greatest extent possible. The slurry wall width will be measured, sounded and/or surveyed to ensure that a minimum width of 3 feet is achieved at the bottom of the excavation. The slurry wall trench will follow the designed alignment within 5 feet of the planned alignment.

Installation activities will not be permitted when severe weather conditions may compromise worker safety or the quality of the work.

4.8.2 Stormwater Runoff Control Measures

Surface water run-off resulting from storm events that occur throughout the site preparation, construction of the slurry wall, and site restoration will be properly managed. Soil berms will be constructed around the slurry wall work area. In addition, a silt fence will be installed along the northeastern side of the site adjacent to the Lower Lake. If conditions require specialized controls, Shaw will re-evaluate site conditions and propose corrective actions.

4.8.3 Inspection and Maintenance of the Work Site

Inspection and maintenance practices will be conducted to maintain the silt sediments and surface water controls. The inspection and maintenance practices are as follows:

- Control measures will be inspected at least once each week and following any storm event of 0.5 inches of rain or greater;
- Control measures will be maintained in good working order; if repairs become necessary they will be initiated within 24 hours of their identification;
- Silt fencing will be used in active work areas as required; and
- The inspection activities, times, results, and actions implemented will be included in the daily log.

4.8.4 Groundwater Management

The objective of this activity is to manage groundwater that will be encountered during the construction of the slurry wall. Based on September 2006 field activities when ASARCO drilled four soil borings at the slurry wall intended location, groundwater was encountered at between 4 to 7 ft bgs. Excavation into the groundwater table will occur, due to the fact that the slurry wall will extend to a depth of approximately 32 to 37 feet bgs. Although the wall excavation will take place below the existing water table no supplemental dewatering measures such as pumping will be used to control groundwater during construction. The slurry will hold the trench open and will preclude the use of any measures, other than the slurry, to manage the groundwater.

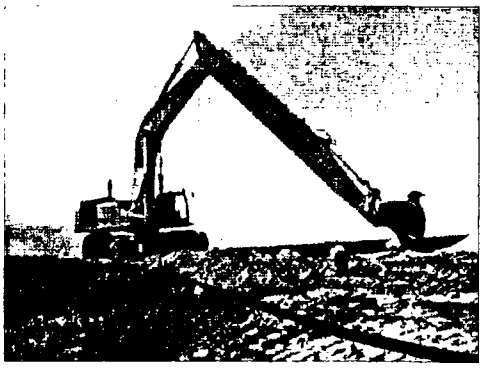
4.9 TRANSPORTATION MANAGEMENT

During the course of the slurry wall construction, soil from ASARCO's onsite borrow area will be will be transported to the slurry wall site.

4.10 TRENCH EXCAVATION PROCEDURES

The trench will be excavated with a long-arm excavator equipped with a 3 foot wide bucket, with a minimum weight of 170,000 pounds. The 3 foot plan width of the trench will be achieved by excavating the soil to a width of at least one bucket. The excavator will remove the soils and place the excavated soil into a "clean" backfill stockpile or on a screen. The screen will segregate unsuitable material (spoils) from usable backfill soil. Unsuitable spoils will be stockpiled on site. Spoils stockpiled within the alignment of the slurry wall will be stockpiled in bermed, unlined areas to permit groundwater to drain back within the alignment of the slurry wall. Due to the limited work space within the slurry wall alignment it may be necessary to stockpile some excavated rock and spoils outside the slurry wall alignment. Excavated rock and unsuitable materials stockpiled outside the slurry wall alignment will be placed on a lined containment berm. A containment berm or other structure will be constructed prior to "remote" stockpiling of excavated rock or unsuitable soils (spoils). The containment berm will be lined with six (6) mil visqueen to create a "lined' bottom. Soils will be placed within the containment berm on top of the liner. As necessary due to inclement weather (e.g., rain, snow, high winds), the stockpile will be cover with visqueen and anchored in place with sand bags.

Suitable excavated soil will be used in the slurry backfill mix. A loader and/or smaller excavator will be used to assist the excavator in stockpiling the unsuitable spoils and suitable soils. The usable excavated soil stockpile area will be in close proximity to the slurry mixing operations. The spoils will be stockpiled in a separate stockpile(s) located within or adjacent to the slurry wall alignment or on nearby surfaced parking/roadways. Excavation will proceed through the slurry to the plan depth, with the trench filled with slurry. Excavated soils will be wet from slurry and groundwater, which will be allowed to drain back into the trench.



Large Long-Stick Excavator

Measurements below the slurry level will be made with a sounding cable. A sounding cable is a special surveyor's tape with a weight attached to the end (similar to a large plumb bob) so that the depth can be measured from the surface to the bottom of the trench. Experienced personnel can determine the depth to the bottom and certain features of the bottom (e.g., the presence of boulders) by feeling with the sounding cable.

Sounding Trench

After the plan trench depth is achieved, the depth will be measured by sounding on 25 foot horizontal intervals for the entire 800 foot length of the slurry wall. Depth measurements will be made along both sides of the trench. The trench width will be measured by simultaneously sounding both sides of the trench and measuring the horizontal distance between measurements. The bottom of the trench may be cleaned repeatedly and re-measured until the plan depth and width are assured.

4.11 BACKFILL PROCEDURES

The SB backfill slurry material will be mixed on the ground surface adjacent to the trench using a bulldozer and/or hydraulic excavator. The backfill material is prepared by sluicing the soil with slurry and then tracking and blading or bucket until the mixture appears homogenous and the proper consistency is reached. The prepared material is then pushed or placed into the trench at the point where backfill rises to the ground surface, thus avoiding segregation that might be caused by free dropping through the slurry. The slope of the backfill advances by a combination of mud wave and sliding down the face of the previously placed backfill. Ideally, the backfill should not be so stiff that a steep slope will form below the slurry surface, risking the possibility of folding and trapping pockets of slurry within the backfill, nor should it be so fluid that segregation might occur during placement. The slurry used for sluicing the backfill may be from fresh slurry or slurry from the trench.

4.12 DEMOBILIZATION AND SITE RESTORATION

Upon completion of installation activities, heavy equipment will be decontaminated and demobilized from the project site. All materials and supplies will be removed from the site. Installation equipment will be brushed off and washed, as necessary, to remove all soil or debris from the equipment before removal from the site. Temporary facilities (e.g., field office, port-a-johns, decontamination pad) and signs erected during this work will be removed. The soil berms and silt fence stormwater controls will remain in place. The construction fence will also remain in place.

After the construction of the slurry wall, site closure will include demobilizing Shaw personnel, equipment, and subcontractors. All debris and trash will also be placed in ASARCO-provided dumpsters. Pre-final and final inspections will be conducted to ensure that the site is returned to contractual conditions. ASARCO will sign-off on the final inspection to concur that the site was returned to contractual conditions.

5.0 FINAL REPORT

Following completion of the slurry wall construction, a Final Report will be generated and submitted to ASARCO. At a minimum, this report shall document the following:

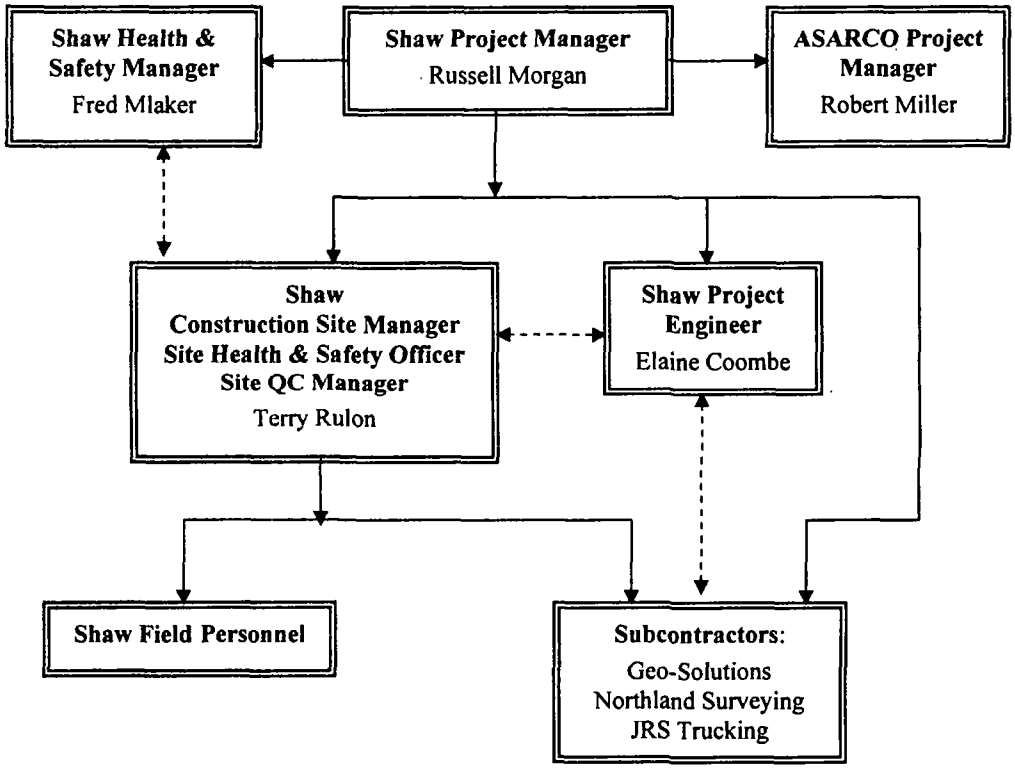
- Documentation of the slurry wall construction;
- Copies of the Field Activity Daily Logs (FADL); and
- A statement that the work was completely substantially in accordance with the Work Plan

6.0 REFERENCES

ASARCO, Inc. 1994. *East Helena Plant. Safety Orientation for Contractors.* March 1994.

FIGURES

FIGURE 6
PROJECT ORGANIZATIONAL CHART



TABLES

TABLE 1
KEY PROJECT CONTACTS
EAST HELENA SITE
EAST HELENA, MONTANA

Title	Name	Business Phone	Mobile Phone	FAX	E-Mail Address	City, State
ASARCO Project Manager	Bob Miller	253-752-1470 x224	253-820-9819	253-752-7663	Romiller@ASARCO.com	Tacoma, WA
ASARCO Site Manager	Blaine Cox	406-227-4098		406-227-2256	Bcox@ASARCO.com	East Helena, MT
ASARCO Environmental Manager	Jon Nickel	406-227-4529		406-227-2256	Jnickel@ASARCO.com	East Helena, MT
Shaw Project Manager	Russell Morgan	503-603-1011		503-603-1001	Russell.morgan@shawgrp.com	Portland, OR
Shaw Construction Site Manager	Terry Rulon	303-791-5256	303-887-8464		Terry Rulon@shawgrp.com	Littleton, CO
Shaw Project Engineer	Elaine Coombe	303-741-7550		303-793-5222	Elaine.coombe@shawgrp.com	Centennial, CO
Slurry Wall Subcontractor, Geo-Solutions	Steve Day	720-283-0505	303-601-3274	720-283-8055	sday@geo-solutions.com	Littleton, CO

APPENDIX A

QUALITY CONTROL PLAN

APPENDIX B

BENCH SCALE LABORATORY RESULTS SUMMARY

COMPATIBILITY TESTS

DatabaseID=46582C252520404 1493D5620 | ContactID=4257203121203E2A5B2F5520 | Memorandum from Geo-Solutions

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Date: 10/1/06
To: Russ Morgan, Elaine Coombe, Shaw
From: Steve Day, Geo-Solutions
Via: email

Subject: Compatibility Testing for Slurry Cutoff Wall, Asarco Site, East Helena, MT

Russ and Elaine:

This is the first in a series of memos to report to you on the progress of our efforts to complete a laboratory design mix program to develop a compatible and low permeability mixture of materials to serve as the backfill for a slurry wall at the Acid Plant Sediment Drying Area at the East Helena ASARCO Smelter Facility. When this design mix effort is complete, we will compile and summarize the data from these memos into a final report.

Our participation in this project is provided in accordance with our pending subcontract and our proposal to Shaw of 7/17/06 for this work and our participation in the construction of the slurry wall in accordance with our proposal of 7/18/06. This memo presents the test results we have obtained to this date and our work continues.

Outline of Testing Program

In order to be effective, a slurry cutoff wall must be compatible with the local groundwater and provide a low permeability barrier to that groundwater. The Asarco site is known to be contaminated with high levels of arsenic which may negatively affect bentonite clay, the principal additive in most slurry walls. Accordingly, a laboratory study is being enacted to pre-determine the compatibility of the slurry wall materials and determine the optimum amount of additives to use in the slurry wall to provide a groundwater barrier with a hydraulic conductivity (or permeability) of 1 x 10^{-7} cm/sec or less.

Due to the uncertainty in compatibility and the need to act quickly, two types of slurry wall materials are being considered; soil-bentonite (SB), and soil-cement-bentonite (SCB). SB slurry walls generally provides the lowest permeability barrier, while SCB is slightly more permeable, but sometimes more resistant to some contaminates.

The testing program is designed to be completed in phases as follows:

1. Characterize available site materials, i.e. slurry mixing water, potential trench spoils, and borrow materials.
2. Perform index tests for compatibility with commercial clays (e.g. bentonite) and the site groundwater. The objective of these tests is to quickly eliminate any additives which indicate a potential incompatibility with the groundwater. The principals of Geo-Solutions are among those who developed these special tests.
3. Perform index tests for compatibility with cement grouts (e.g. cement-bentonite) and the site groundwater. The objective of these tests is to eliminate any grouts which demonstrate a potential incompatibility with the groundwater. For this project, Phase 2 and 3 are being performed simultaneously.
4. Formulate and test a number of trial SB and/or SCB mixtures and test these mixtures for permeability to tap water. The objective of these tests is to develop a mixture with a low permeability using the materials developed in Phases 1, 2 and 3.
5. Formulate and test the best mixtures from Phase 4 for permeability to the site groundwater. In order to fully document our success, the mixtures tested in Phase 5 are subjected to at least 2 pore volumes of permeation with the site groundwater. It has been our experience that this phased approach guarantees a successful mixture.

Laboratory

Laboratory testing is being completed by Advanced Terra Testing (ATT) of Lakewood, CO under the direction of Steve Day of Geo-Solutions. ATT is fully qualified, licensed and experienced to perform all type of soil and rock testing. ATT is capable of performing tests with radioactive and hazardous materials. The contact at ATT is Kerry Repola at 303-232-8308. Mr. Day and ATT have worked together on this type of testing for more than a decade. Their combined experience includes major groundwater barrier projects for Rocky Mountain Arsenal Chemical Warfare Materials Disposal sites, Rocky Flats Nuclear Weapons site, Superfund sites, and many other similar sites.

Standards and Methods

The standards and methods to be employed in the design mix are listed in the table below.

Test	Standard or Reference
Grainsize	ASTM D422
Fines Content	ASTM D1140
Atterberg Limits	ASTM D4318
Moisture Content	ASTM D2216

Soil Classification (USCS)	ASTM D2487
Water Quality (ph, Hardness, Alkalinity, TDS)	Hach Test or equal
Slurry Preparation	API 13A mod.
Soil-Cement sample preparation	ASTM D4832
Slump (mini-slump method)	ASTM D143 mod.
Viscosity and Density	API RP 13B-1
Filtrate, pH, and temperature	API RP 13B-1
Bleed and Set	ASTM C940 mod.
Penetration Resistance	ASTM D1558 mod.
Accelerated Cure	ASTM D684 mod.
Unconfined Compression Strength	ASTM D1633 & D2166
Hydraulic Conductivity (permeability)	ASTM D5084
Hydraulic Conductivity: Long Term	ASTM D7100
Pan-Set	CRA, June 1991
Slake / Immersion	ASTM C267 & D4644 mod.
Chemical Dessication	Alter et. al. 1984
Sedimentation / Flocculation	Ryan 1987
Long-term Filtrate w/leachate	D'Appolonia 1980

Phase 1 Testing – Site Resources

We consider the available site resources to include the slurry mixing water, trench spoils, and borrow materials. Samples of these materials were recently provided by Asarco and received at the laboratory. Since previous testing has been completed on this site, and because groundwater chemistry is available from other sources, we have concentrated on developing composite of the site soils that model potential trench spoils. Based on our previous experience on site, we expect to encounter a considerable volume (about 50%) of cobbles and boulders that will not be suitable for slurry wall backfill. The volume of trench spoil lost in cobbles and boulders will be made up with CAMU material. The fines and water content of these soils are summarized in the table below.

Property	**Test Pit Composite**	**CAMU Composite**
Water Content (%)	10.7	9.6
Fines (%<#200 sieve)	22	23.1

The test pit composite soils have been pre-screened to less than 3 inches and then laboratory screened to less than 0.5 inch for laboratory testing purposes. In the field, we expect to screen the trench spoils to less than 3 inches. The available fines should be adequate to create a low permeability SB or SCB mixture.

Phase 2 Testing – Clay Compatibility via Index Tests

Three commercial clays were subjected to compatibility testing with the groundwater: API bentonite (Fed Jel 90), salt resistant bentonite (SR bentonite or SW 101), and attapulgite clay (Florigel H-Y). The API bentonite is representative of the most common slurry wall material. SW 101 is a specially treated bentonite clay, most often used in off-shore drilling

and typically mixed with salt water. Attapulgite is a clay from northern Florida that does not swell like bentonite and has been used on some other severely contaminated sites and can be mixed with salt water. The properties of the 6% slurries with the Upper Lake water are shown in the table below.

Property	Bentonite	SR Bentonite	Attapulgite
Viscosity (MF seconds)	40	>180	26
Filtrate (ml/ 30 min.)	17	8.3	79
Density (pcf)	65	65	65
pH	8.5	9	9.4

Index-type compatibility tests are performed with the clay slurries to detect potential gross incompatibility or other reaction between the slurries and site groundwater. The tests are performed by first creating a slurry (6% clay with 94% water) from Upper Lake water and a commercial clay.

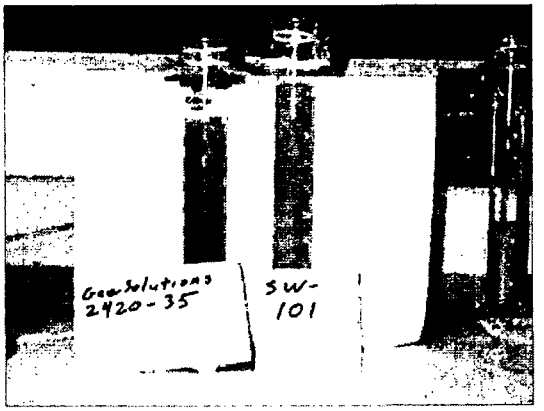
Sedimentation/flocculation tests are performed to help determine whether the clay will fall out of suspension in the presence of the groundwater during construction. Slurries are made with each of the clays and diluted 1:1 with tap water and groundwater. The slurries are poured into graduate cylinders and then observed for at least 7 days. Comparisons are made between slurries diluted with tap water and groundwater.

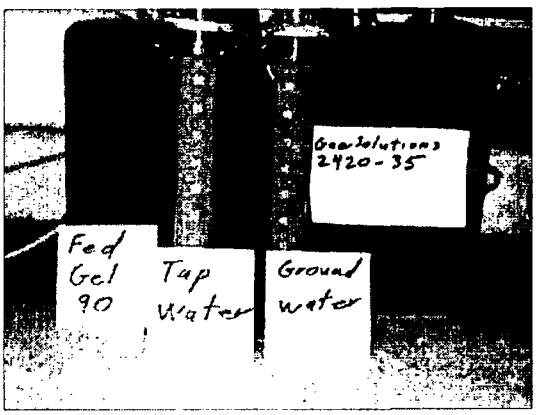
Chemical desiccation tests are performed to help determine if the groundwater affects the chemical structure of the clay. Slurries are made with each of the clays, as previously described and diluted at a 1:1 with tap and groundwater. These mixtures are poured onto glass plates and allowed to dry for about two weeks. The cracking pattern of the dried slurry is then examined for any unusual patterns. Comparisons are made between slurries diluted with tap water and groundwater.

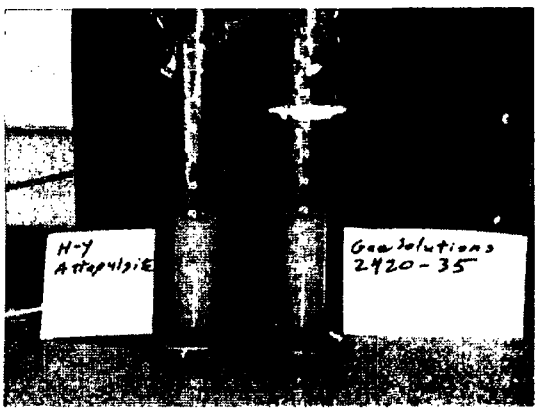
Filter press permeability tests are performed to help determine if the groundwater will degrade the filter cake of the commercial clay. The test is performed by first completing two standard filtrate tests (30 minutes at 100 psi) with each of the clay slurries. Next, the supernate from each test is decanted and the two cells (with filter cakes still intact) are refilled one with tap water and one with groundwater. The test cells are again pressurized (at 100 psi) and the test continued for about 3 hours while the flow rate of the waters through the two filter cakes is monitored. The flow rates can be compared as the ratio of the filtrate of the groundwater to the filtrate of the tap water verses the pore volumes of flow. A ratio where the groundwater flows through the filter cake twice as fast as tap water flow through the filter cake is considered potentially incompatible.

Phase 2 Testing – Results

The results of the sedimentation tests are shown in the photographs below.



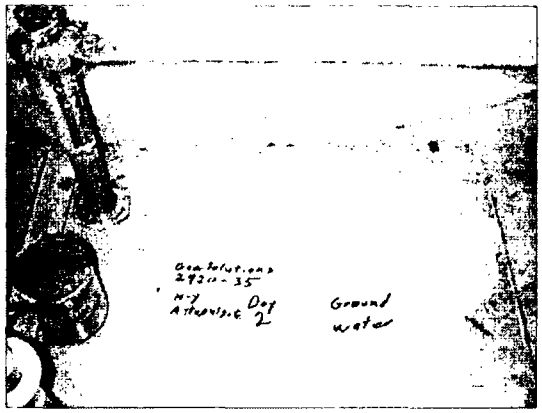


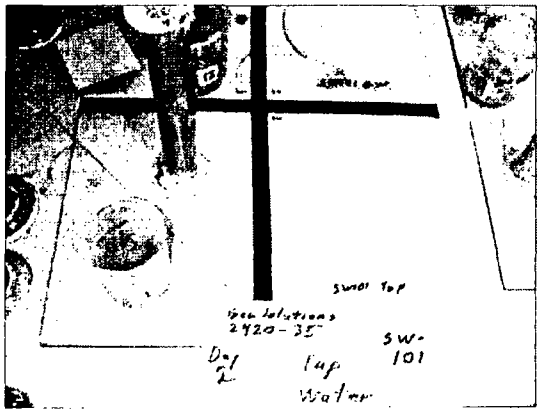


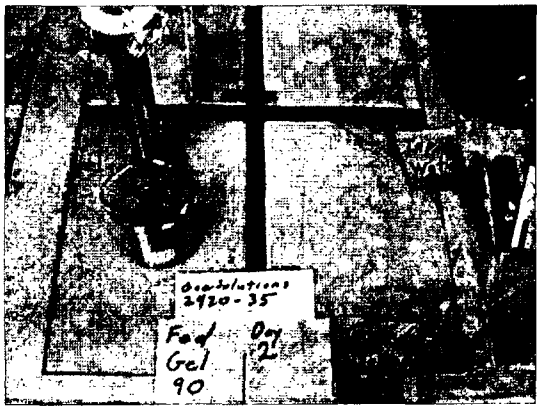
The best results were demonstrated by the Fed Jel 90 (API-type) bentonite. There was no indication of any sedimentation or flocculation with the API bentonite. The attapulgite test appeared to demonstrate the worst results, but this is probably due to inadequate mixing by the laboratory. Attapulgite requires very aggressive mixing. There appears to be a minor sedimentation with the SW 101 in tap water.

Issued by:
Denver Office: 26 W. Dry Creek Circle, Suite 600, Littleton, CO 80120, Ph: 720-283-0505, Fax: 720-283-8055.
Check out our web site at www.geo-solutions.com

The results of the chemical desiccation test are shown in the picture below:

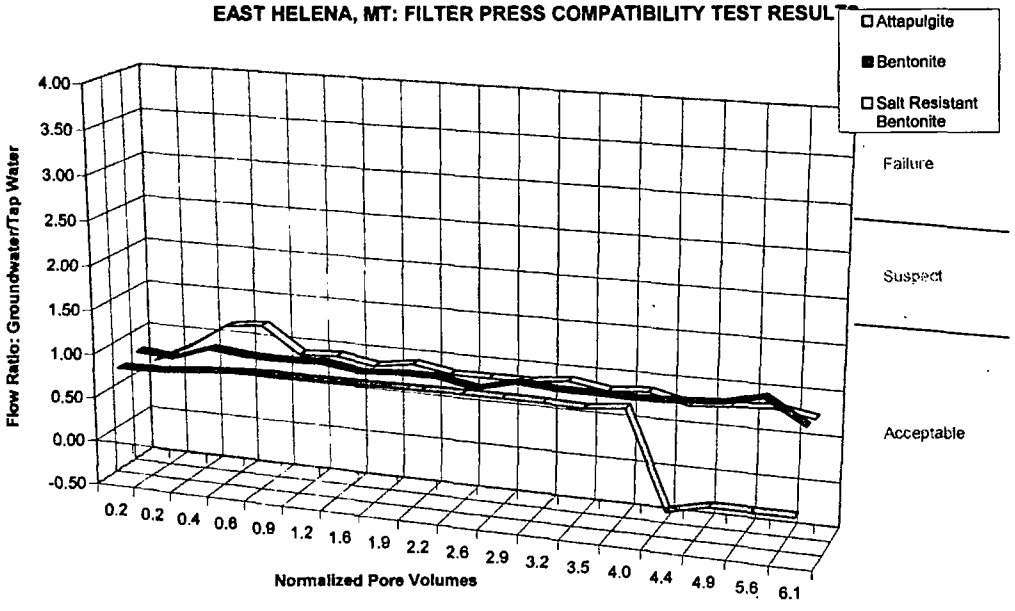






There is no cracking or other indications of chemical desiccation in any of the tests. All of the clay performed similarly.

The results of the modified filter press test are presented in the graph, below.



	0.2	0.2	0.4	0.6	0.9	1.2	1.6	1.9	2.2	2.6	2.9	3.2	3.5	4.0	4.4	4.9	5.6	6.1
Attapulgite	0.82	0.83	0.87	0.90	0.92	0.91	0.92	0.93	0.93	0.94	0.94	0.93	0.92	0.97	-0.1	0.00	0.00	0.00
Bentonite	0.89	0.86	1.00	0.96	0.96	0.97	0.91	0.94	0.94	0.86	0.97	0.94	0.94	0.93	0.95	0.98	1.08	0.82
Salt Resistant Bentonite	0.67	0.88	1.14	1.20	0.91	0.93	0.87	0.93	0.86	0.86	0.86	0.92	0.85	0.88	0.78	0.81	0.85	0.77

The ratio of flow with groundwater and tap water are similar and acceptable for all three clays. Please ignore the ratio for attapulgite after 4 pore volumes (trend after 4.4 pore volumes is a function of Excel graphing, not the clay).

Based on these results, API-type bentonite is compatible with the site groundwater and recommended for Phase 4 testing.

Phase 3 Testing – Grout Compatibility via Index Tests

Index-type compatibility tests are being performed with cement grouts to detect potential incompatibilities or reaction between the grouts and site groundwater. In the Pan test, the fluid grout is poured into a pan filled with either groundwater or tap water. The grouts are tested for penetration resistance as they set and harden under the waters to detect any observable differences in the setting process due to the different waters. These tests are still in progress.

In the Slake test, hardened cylinders of grout are immersed in groundwater and tap water. The cylinders are observed for at least 2 weeks, then removed and cut into sections to detect any changes due to immersion in the different waters. These tests are in progress.

Phase 3 Testing – Results

At this time only preliminary results are available from the pan test. The initial results indicate no incompatibility.

The slake test are started, but at this time no results are available.

Based on the available results, we plan to begin Phase 4 testing with bentonite clay and would only return to SCB mixtures if unusual results were obtained with SB.

Phase 4 – Soil-Bentonite Design Mixtures

Based on the superior results with the API-type bentonite, the following SB mixtures are being formulated and will be tested as soon as possible. We do not see a need to test any SCB mixtures.

Mix No.	Soils (50/50 blend)	Additive	Additive Added	Slump (inches)
1	CAMU / Composite	API bentonite	1%	4 to 6
2	CAMU / Composite	API bentonite	2%	4 to 6
3	CAMU / Composite	API bentonite	3.5%	4 to 6
4	CAMU / Composite	API bentonite	6%	4 to 6
5	CAMU	API bentonite	1%	4 to 6

It is expected that the addition of bentonite slurry to create workable SB mixtures with a slump of 4 to 6 inches and will add about 1% bentonite to the soils. The actual of bentonite amount added will be measured. Mix 5 is included as a worst case if all of the trench spoils should prove to be unacceptable. These mixtures will be tested in a flexible wall permeameter at an effective confining stress of 10 psi and a gradient of less than 30 with tap water as the permeant.

We plan to start making these mixtures on October 2, 2006. We have only limited composite soils, but if there are no additional tests required, we estimate that the testing can be completed with the available materials.

Please feel free to call me anytime. Cell: 303-601-3274

Steve

SOIL-BENTONITE DESIGN MIXTURES

(Place holder for test results)

APPENDIX C

SOIL BORINGS

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-1

Date Hole Started: 7/19/06 Date Hole Finished: 7/21/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
COORDINATES
Northing:
Easting:
Ground Elevation:

County: Lewis and Clark State: Montana
Property Owner: Asarco Inc.
Legal Description:
Location Description: Former Acid Plant Sediment Drying Area
Weather Conditions:

Recorded By: GB
Drilling Company: Boland Drilling
Drilling Crew:
Driller: James/Brian
Drilling Method: Air Rotary
Drilling Machine:
Drilling Fluid: Air
Hole Diameter (in): 8
Total Depth Drilled (ft): 31
Water Table Depth (ft):

SAMPLE METHOD ASTM Std:
Hammer Drop System:
Type:
Length (in):
Inside Diameter (in):
Liner:
SAMPLE RODS Type:
Size (ID/OD, in):
Section Length (ft):

Note: For ASTM standard D 1586 indicate the method of advancing, cleaning and maintaining the boring. Also the depth at which a water table was encounted including noted loss of drilling fluid with the date and time of occurance.

Remarks: Hole abandoned with Bentonite chips to surface - hydrated.

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
5	01	GRAB			0.0 - 5.0'		0.0 - 5.0' **Gravelly Sand/Fill** Gray fine to coarse poorly sorted sand with 15% gravel. Most likely fill material. Large cobble at 5'.
10	02	GRAB			8.0 - 17.5'		8.0 - 9.5' **Sand and Gravel** Fill: Gray/white/yellow fine to coarse poorly sorted sand with 35 - 40% 1" angular gravel. Cobble at 9'.
	03	SS			9.5 - 19.3'		9.5 - 9.8' **Slag/Silty Clay** Black slag mixed with silty clay.
	04	SS			10.0 - 22.0'		10.0 - 12.0' **Sandy Gravel** Black/gray gravel with coarse sand
15	05	GRAB			15.0 - 31.0'		15.0 - 16.0' **Gravelly Silty Sand** Black fine to coarse sand with 2"+ gravel at 15.8 and 5% silt throughout.
	06	GRAB			16.0 - 34.0'		16.0 - 18.0' **Sandy/Silty Clay** Dark gray soft clay with 10% silt and 10% fine grained sand
20	07	GRAB			20.0 - 42.0'		20.0 - 21.2' **Sandy Silt** Dark gray loose silt with 20 - 25% fine sand and trace of clay, some roots and metallic (mica?) in silt
	08				22.0 - 46.0'		21.2 - 22.0' **Silty Sand** Dark gray fine to med sand with 20% silt. Gravel in spoon. Mica throughout.
25	09				24.0 - 49.0'		22.0 - 24.0' **Gravelly Sand** Dark gray fine to coarse poorly sorted sand with 1"+ angular gravel. 10% silt. Mica throughout.
	10				25.0 - 51.0'		24.0 - 25.0' **Sandy Gravel and Cobbles** Fine to coarse gravel and some cobbles with medium to coarse sand.
	11				26.1 - 54.1'		25.0 - 26.0' **Gravelly Sand with Cobbles** *As above with large cobbles at 26'*
	12						26.0 - 30.0' **Gravelly Sand** Gray coarse to medium sand with some gravel. Gravel predominantly black fine igneous rocks. Subrounded 1"-2" diameter. Hole producing high flows. Slightly less gravel lower 2'.
30	13				28.0 - 58.0'		**Ash** Green (chlorite) within some coarser white feldspar grains and some fragments of semi-consolidated silty clay. (Ash Unit)
	14						
35							
40							
45							

GEOTECH_REV2 1054.GPJ HYDHLN1.GDT 9/7/06

Continued Next Page

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-1

Date Hole Started: 7/19/06 Date Hole Finished: 7/21/06

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100							
105							
110							
115							

GEOTECH_REV2 1054.GPJ HYDHLN1.GDT 9/7/06

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-2

Date Hole Started: 8/21/06 Date Hole Finished: 8/21/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
COORDINATES
Northing:
Easting:
Ground Elevation:

County: Lewis and Clark State: Montana
Property Owner: Asarco Inc.
Legal Description:
Location Description: Former Acid Plant Sediment Drying Area
Weather Conditions:

Recorded By: JLC
Drilling Company: Boland Drilling
Drilling Crew:
Driller: Rick Johnson/Chuck Belter
Drilling Method: Hollow Stem Auger
Drilling Machine:
Drilling Fluid: None
Hole Diameter (in): 8
Total Depth Drilled (ft): 31.5
Water Table Depth (ft): 3.90

SAMPLE METHOD ASTM Std:
Hammer Drop System:
Type:
Length (in):
Inside Diameter (in):
Liner:
SAMPLE RODS Type:
Size (ID/OD, in):
Section Length (ft):

Note: For ASTM standard D 1586 indicate the method of advancing, cleaning and maintaining the boring. Also the depth at which a water table was encounted including noted loss of drilling fluid with the date and time of occurance.

Remarks: Hole abandoned with Bentonite chips to surface - hydrated.

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
5		GRAB			0.0 - 5.0'		0.0 - 5.0' **Silty Sand and Gravel** Brown silty sand and gravel
10		SS			6.0 - 12.5'		5.0 - 6.0' **Sandy Silt and Sand Beds** Black sandy, clayey silt with platy, shiny (micaceous) flakes interbedded with fine to coarse sand - all stained black (organics). No particular odor. 6.0 - 6.5' ***Organic Silty Clay*** Black organic (roots and wood evidence) soft silty clay with micaceous flakes. Wet.
15		SS			10.0 - 21.5'		10.0 - 10.7' **Sand** Fine to medium sand with black stain. 10.7 - 11.5' ***Organic Silt*** Black slightly clayey, slightly sandy silt with organics and micacous flakes. 15.0 - 15.7' **Sand** Black stained fine to medium sand, subrounded.
20		SS			15.0 - 31.5'		15.7 - 16.5' **Organic Silt and Clay** Black clayey silt to silty clay by 2" depth, plastic with lots of organic material and micaceous flakes. 20.0 - 21.1' **Organic Silt** Black with micaceous flakes, fine sandy silt with one layer of gray silt towards the top of spoon. Some clayey component. Driller noted harder material starting at 17.5.
25		SS			20.0 - 41.1' 21.1 - 42.6'		21.1 - 21.5' **Sand, Gravel, Cobble** Sub-rounded sand and angular gravel and cobble. Black staining. 25.0 - 26.1' **Silty Sand** Thin layer multi-colored fine to coarse, mostly medium silty sand. Stained black.
30		SS			25.0 - 51.5'		26.1 - 26.5' **Gravel and Cobble** Coarse gravel and cobble with medium sand. 30.0 - 30.2' **Sand and Gravel** Sand and Gravel
35		SS			30.0 - 61.5'		30.2 - 31.5' **Ash** Tan to yellow green with whitish green lenses, silty clay to clayey silt with a structured appearance like weathered bedrock (Ash)
40							
45							

GEOTECH_REV2 1054.GPJ HYDHLN1.GDT 9/7/06

Continued Next Page

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-2

Date Hole Started: 8/21/06 Date Hole Finished: 8/21/06

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100							
105							
110							
115							

GEOTECH_REV2 1054.GPJ HYDHLN1.GDT 9/7/06

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-3

Date Hole Started: 8/21/06 Date Hole Finished: 8/21/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
COORDINATES
Northing:
Easting:
Ground Elevation:

County: Lewis and Clark State: Montana
Property Owner: Asarco Inc.
Legal Description:
Location Description: Former Acid Plant Sediment Drying Area
Weather Conditions:

Recorded By: JLC
Drilling Company: Boland Drilling
Drilling Crew:
Driller: Rick Johnson/ Chuck Belter
Drilling Method: Hollow Stem Auger
Drilling Machine:
Drilling Fluid: None
Hole Diameter (in): 8
Total Depth Drilled (ft): 31.5
Water Table Depth (ft): 6.85

SAMPLE METHOD ASTM Std:
Hammer Drop System:
Type:
Length (in):
Inside Diameter (in):
Liner:
SAMPLE RODS Type:
Size (ID/OD, in):
Section Length (ft):

Note: For ASTM standard D 1586 indicate the method of advancing, cleaning and maintaining the boring. Also the depth at which a water table was encounted including noted loss of drilling fluid with the date and time of occurance.

Remarks: Hole abandoned with Bentonite chips to surface - hydrated.

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
		GRAB			0.0 - 4.0'		0.0 - 0.2' **Asphalt** Asphalt 0.2 - 4.0' **Sandy Silt** Dark brown slightly fine sandy silt
5		GRAB SS			5.0 - 10.5' 5.5 - 12.0'		5.0 - 5.5' **Sand** Brown fine to medium sand, few coarse grains 5.5 - 6.5' **Sand and Gravel / Fill** Red/rust sand and gravel with appearance of brick
10		SS			10.0 - 21.5'		10.0 - 10.5' **Poorly Sorted Sand and Gravel** Multi-colored with black staining, poorly sorted sand and gravel - angular and Wet. No particular odor.
15		SS			15.0 - 31.5'		15.0 - 19.5' **Organic Silty Clay** Thin layer as above. Black organic, very soft, plastic silty clay Spoon from 15 - 16.5, driller noted material extended to about 19.5'.
20		GRAB			19.5 - 41.0'		19.5 - 21.5' **Sand and Gravel** Brown with black staining, clayey medium sand with some fine and coarse sand and fine to coarse gravel (50%)
25		SS			25.0 - 51.5'		25.0 - 25.3' **Well Graded Sand** Multi-colored (mostly brown/white/tan) fine well graded sand with few fines. 25.3 - 26.0' **Sand** Multi-colored (mostly white/tan/brown) medium to coarse sand with few fines.
30		SS			30.0 - 6[illegible].5'		**Gravel** *Driller noted harder drilling - Gravel layer* 30.0 - 30.1' **Well Graded Sand** Fine to medium sand 30.1 - 31.5' **Ash** Dark tan to gray green clayey silt, plastic with minerals and structured appearance. Grading to Tan with rounded fine gravel size white lenses, sandy, clayey silt, less plastic. (Ash)
35							
40							
45							

GEOTECH_REV2 1054.GPJ HYDHLN1.GDT 9/7/06

Continued Next Page

Hydrometrics, Inc.
Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-3

Date Hole Started: 8/21/06 Date Hole Finished: 8/21/06

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
50							
55							
60							
65							
70							
75							
80							
85							
90							
95							
100							
105							
110							
115							

GEOTECH_REV2 1054.GPJ HYDHLN1.GDT 9/7/06

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-4

Date Hole Started: 8/17/06 Date Hole Finished: 8/18/06

Client: ASARCO, INC.
Project: Interim Measures East Helena Facility
COORDINATES
Northing:
Easting:
Ground Elevation:

County: Lewis and Clark State: Montana
Property Owner: Asarco, Inc.
Legal Description:
Location Description: Former Acid Plant Sediment Drying Area
Weather Conditions:

Recorded By: JLC
Drilling Company: Boland
Drilling Crew:
Driller: Rick Johnson/Chuck Belter
Drilling Method: Air Rotary/ODEX
Drilling Machine:
Drilling Fluid: None
Hole Diameter (in): 6
Total Depth Drilled (ft): 37
Water Table Depth (ft):

SAMPLE METHOD ASTM Std:
Hammer Drop System:
Type:
Length (in):
Inside Diameter (in):
Liner:
SAMPLE RODS Type:
Size (ID/OD, in):
Section Length (ft):

Note: For ASTM standard D-1586 indicate the method of advancing, cleaning and maintaining the boring. Also the depth at which a water table was encounted including noted loss of drilling fluid with the date and time of occurance.

Remarks: Hole abandoned with Bentonite chips to surface - hydrated.

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES
5					
	1	SS			5.0 - 11.5'
10					
	2	SS			10.0 - 21.5'
	3	GRAB			11.5 - 26.5'
15					
	4	SS			15.0 - 31.5'
20					
	5	SS			20.0 - 41.5'
	6	GRAB			21.5 - 44.0'
	7	GRAB			22.5 - 47.5'
25					
	8	SS			25.0 - 51.5'
	9	GRAB			26.5 - 56.5'
30					
	10	SS			30.0 - 61.0'
	11	GRAB			31.0 - 66.0'
35					
	12	SS			35.0 - 72.0'
40					
45					
50					

GRAPHICS

GEOLOGICAL DESCRIPTION

0.0 - 5.0' **Fill**
Fill

5.0 - 6.5' **Sandy Silt / Fill**
Red/Rust sandy silt and broken granular material - appearance of brick.
Water

10.0 - 11.5' **Silty Sand and Gravel**
Red/Rust med to coarse silty sand and gravel, stained in black organics. Wet with no particular odor.

11.5 - 15.0' **Well Sorted Sand and Gravel**
Red/rust/brown/black coarse sand and fine gravel

15.0 - 16.3' **Sand and Gravel**
Mulitcolored and stained black, fine sand to fine gravel - angular

16.3 - 16.5' **Organic Silt and Clay**
Black clayey organic silt to silty clay (marsh deposit clay).

*20.0 - 20.1' **Organic Silt and Clay***
Thin Layer as above.

20.1 - 20.4' **Organic Silty Clay**
Black silty organic clay

20.4 - 21.0' **Silty Sand With Gravel**
Tan and orange brown silty sand with fine gravel in a consolidated matrix

21.0 - 21.5' **Sandy Gravel**
Black stained sandy coarse gravel with some fine gravel. Mostly unconsolidated.

21.5 - 25.0' **Sand and Gravel**
Mostly white and black medium to coarse sand and fine gravel, subangular, with little fines. Black coating from organics.

25.0 - 25.5' **Sand with Gravel**
Well graded fine to medium sand with few sub-rounded gravel.

25.5 - 26.5' **Sand, Gravel and Cobble**
Fine to medium sand, gravel, cobble - angular with little fines

26.5 - 30.0' **Sand and Gravel**
Mostly black with brown and white, medium to coarse sand and fine gravel, sub-angular

30.0 - 31.0' **Sand with Gravel and Cobble**
Fine to coarse sand, mostly medium sand and some gravel and cobble

31.0 - 35.0' **Sand and Gravel with Organic Silt**
Medium to coarse sand and gravel, subangular with few chunks of black organic silt in upper 2.5'. Lower portion same with coating of black fines

35.0 - 37.0' **Ash**

Continued Next Page

Hydrometrics, Inc.

Consulting Scientists and Engineers
Helena, Montana

Soil Boring Log

Hole Name: APBH-4

Date Hole Started: 8/17/06 Date Hole Finished: 8/18/06

DEPTH	SAMPLE NUMBER	SAMPLE TYPE	BLOW COUNT	RECOVERY (feet)	DRILLING AND GEOTECHNICAL NOTES	GRAPHICS	GEOLOGICAL DESCRIPTION
							Grey green silty clay to clayey silt. Very soft and plastic with grainy appearance, coarse sand and fine gravel. Color turning to whitish rust at depth (Ash).

55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130

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APPENDIX D

CONSTRUCTION SPECIFICATIONS

GUIDE SPECIFICATION

SOIL-BENTONITE METHOD (NO PERM SPEC)

SLURRY WALL

1.1 SCOPE

This section of the specifications includes requirements for Slurry Trench Wall as indicated on the drawings, as hereinafter specified, or as required to properly complete the work.

1.2 GENERAL

The work covered by this section of the specifications consists of furnishing all plant, labor, equipment, and materials and of performing all operations in connection with constructing the slurry trench cut-off wall.

1.3 QUALIFICATION OF CONTRACTOR

The Contractor will submit evidence that he is competent to construct a slurry trench. This evidence will insure that the Contractor or his subcontractor or his technical advisor will have sufficient competent personnel to carry out the operations specified, and such personnel will have previous experience in this type of construction. In particular, a construction and slurry specialist(s) shall be used to supervise the construction, slurry preparation, and quality control.

1.4 CHARACTER OF OVERBURDEN MATERIALS

A generalized description of the typical overburden through which the slurry trench cut-off is to be excavated is indicated by boring logs included in the Appendix C of the Work Plan. In general, the slurry wall shall extend through the overburden and tie into the clay layer as indicated in the Figures 2 through 5 of the Work Plan.

1.5 EXCAVATION OF SLURRY TRENCH

1.5.1 General Requirements

An impervious slurry trench cut-off wall shall be constructed to the lines, grades, and cross sections as indicated in the Figures 2 through 5 of the Work Plan. The trench shall have essentially vertical walls, a minimum width of 3 feet and shall extend through the aquatard (ash unit) to minimum specified penetration of 2 feet.

1.5.2 Prosecution of Work

(A) Slurry will be introduced into the trench immediately after trenching has begun and shall be maintained in the trench during excavation and until it is completely backfilled. The slurry level shall be maintained at least 3 feet above the groundwater level.

(B) The Contractor shall maintain the stability of the excavated trench at all times for its full depth. The level of the bentonite slurry shall not be permitted to drop more than 3 feet below the top of the slurry trench except as approved by the Contractor's Slurry Wall Specialist.

(C) The Contractor shall have personnel, equipment, and materials ready to raise the slurry level at any time. To this end, the Contractor shall have personnel on call to raise the slurry level, weekends and/or holidays included.

(D) Unless otherwise directed, the bottom of the slurry trench will be keyed the minimum specified penetration (see 1.5.1) into the underlying aquatard (ash unit) beneath the site as indicated by soil borings, except that if the excavator is unable to achieve the minimum specified penetration into weathered rock without the assistance of ripping teeth, blocks or percussion chisels, the minimum penetration requirements will be modified and the trench will extend to the depth where refusal of the excavating equipment is encountered. The

final depth and penetration of the trench shall be measured and checked by the Contractor and approved by the Owner or his representative immediately following excavation.

(E) Upon completion of excavation, any loose material or cuttings shall be removed from the bottom of the trench with the excavator.

(F) The toe of the slope of the trench excavation shall precede the toe of the backfill slope so that the toe of the backfill shall be more than 50 feet away from the toe of the excavation or as required to permit proper cleaning of the trench bottom and to permit inspection and measurement.

1.6 PROPERTIES OF SLURRY

The bentonite slurry shall be a fluid allowing proper excavation of the trench and allowing backfilling with impervious material to form a permanent cut-off wall.

1.6.1 Materials

(A) Bentonite - The bentonite powder or granules used in the slurry shall be natural high-swelling montmorillonite base product and shall meet the requirements of API Specification 13A.

(B) Water - The water shall be clean, fresh, and free from excessive oil, acid, alkali, organic matter, or other deleterious substances. It is the responsibility of the Contractor that the slurry resulting from the water shall always meet the standards in this specification.

(C) Additives - Admixtures such as softening agents may be used to alter the characteristics of the water to permit efficient bentonite consumption.

1.6.2 Slurry Mixture

The bentonite slurry shall consist of a stable colloidal suspension of sodium bentonite in water and shall be controlled in accordance with API RP I3B-1 "Recommended Standard Procedure for Field Testing Water-Based Drilling Fluids" (most current edition), and the following requirements:

(A) At the time of introduction of the slurry into the trench, the initial slurry shall be a mixture of not less than 5 % by weight of bentonite to water. Additional bentonite may be required depending on the hardness and temperature of the water. The slurry shall have a minimum apparent viscosity of 15 centipoises or 40 seconds reading through a Marsh Funnel Viscosimeter, a maximum filtrate loss of 25 cubic centimeters in 30 minutes at 100 psi, and a pH of 6.5 to 10.0.

(B) The slurry mixture in the trench shall have a density not less than 64 pcf (1.03 gm/cc), not greater than 85 pcf (1.36 gm/cc), or as approved by the Contractor's Slurry Wall Specialist..

(C) The slurry mixed with backfill material shall be either slurry taken from the trench or slurry meeting the requirements of slurry introduced into the trench.

(D) If the density of the slurry in the trench exceeds the specified limits, or becomes unworkable, the heavy slurry shall be removed from the trench by airlift pump, excavator, or other methods approved by the Contractor's Slurry Wall Specialist or the excess solids shall be removed from the slurry by screening or centrifugal type slurry desander.

(H) Admixtures of the types used in the control of oil field drilling muds may be used to alter the characteristics of the slurry in the trench only as approved by the Contractor's Slurry Wall Specialist. Peptizing or bulking agents shall not be mixed with the slurry.

1.6.3 Slurry Mixing Plant

(A) All slurry for use in the trench shall be prepared using a suitable mixer. No slurry is to be

made in the trench. Mixing of water and bentonite shall continue until bentonite particles are fully hydrated and the resulting slurry appears homogeneous.

(B) The slurry plant shall include the necessary equipment such as a mixer capable of producing a colloidal suspension of bentonite in water, sumps, pumps, valves, hoses, supply lines, small tools, and all other equipment as may be required to adequately supply slurry to the trench.

(C) Storage tanks may be provided to store initially mixed slurry to allow hydration and to serve as a reserve in cases where substantial loss from the trench through underlying pervious zones or other reasons may occur. The slurry shall be agitated or recirculated in any storage tanks as required to maintain a homogeneous mix.

1.7 BACKFILLING OF SLURRY TRENCH

1.7.1 Materials-
The material for trench backfilling shall be composed of slurry and selected granular soils obtained from the trench excavation and/or an approved borrow area. Dry bentonite, in addition to that added via the slurry shall be added to the backfill at a rate of ___lbs per cubic foot of backfill mix. The soil shall be friable and free from roots, organic matter, or other deleterious materials. The backfill shall be thoroughly mixed and reasonably well graded between the following gradation limits:

Screen Size (U.S. Standard)	Percent Passing by Dry Weight
Determined by design mix	

1.7.2 Mixing -
Stockpiled material from excavation and/or material from borrow shall be mixed and blended by windrowing, disk harrowing, bulldozing, blading, hoeing or by other approved methods. Mixing and blending shall be performed in such a manner as to produce the required gradation of backfill. The backfill material shall be thoroughly mixed into a homogeneous mass, free from large lumps or pockets of fines, sand, or gravel. Occasional lumps of up to 4 inches in their largest dimensions will be permitted. Just prior to placing, the backfill material shall have a slump of 3 to 6 inches. To this end, the materials may be sluiced with slurry during blending operations. Sluicing with water will not be permitted except as approved by the Contractor's Slurry Wall Specialist..

1.7.3 Placing –
The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench. Free dropping of backfill material through the slurry will not be permitted. Initial backfill shall be placed by lowering it to the bottom of the trench with an excavator bucket until the surface of the backfill rises above the surface of the slurry trench at the start of the trench. Additional backfill may then be placed in such a manner that the new material slides down the forward face of the previously placed backfill. The backfill shall not be dropped or deposited in any manner that will cause segregation. An acceptable substitute for the initial placing of backfill by the use of an excavator bucket shall be to begin excavation of a sloping "starter or lead-in" trench" at a point outside of the limits of work which will provide a sufficient distance for the backfill face to form before the toe of the backfill reaches the point where the cut-off is required.

1.8 CAPPING
Capping is not within the scope of work to be performed by Shaw.

1.9 CLEANUP
After completion of the backfill all remaining excavated material and slurry not previously

stockpiled shall be placed within the slurry wall alignment and generally back bladed. Excess slurry shall be disposed of by spreading in thin layers on the area within the slurry wall alignment.

2.0 QUALITY CONTROL

The Contractor shall maintain his own quality control for the cut-off wall construction under the direction of the Contractor's Contractor's Slurry Wall Specialist. Table 1 outlines the Soil - Bentonite Slurry Trench Quality Control Testing Plan.

2.0.1 Trench Continuity and Key

The Contractor shall be responsible for demonstrating to the satisfaction of the Contractor's Slurry Wall Specialist that the trench is continuous and excavated to the minimum specified depth into the underlying aquaclude as shown on Figures 2 through 5. Trench continuity shall be assured by the action of the trench excavation equipment, the digging tools must be able to be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Penetration of the bottom of the trench into the aquaclude shall be demonstrated by observation of the cuttings removed from the trench and by direct measurement of trench depth to the satisfaction of the Contractor's Slurry Wall Specialist.

2.0.2 Slurry and Backfill Mix Materials

(A) Bentonite - Certificate of Compliance with the specification shall be obtained from the material manufacturer.

(B) Water - Water for making slurry shall be tested for pH and total hardness as required to determine the amount of softening agent necessary to assure optimum yield of the bentonite. Tests shall be repeated each time that the water source is changed.

(C) Backfill Mix - Backfill material shall be tested prior to placement in the trench by conducting tests to determine slump and gradation. Testing frequency will be a minimum of one series of tests per 500 cubic yards of backfill material prepared for introduction in the trench. The Contractor's Slurry Wall Specialist shall determine the amount of bentonite added.

2.0.3 Slurry Introduced in the Trench

A complete series of tests shall be conducted on slurry from the pond containing slurry ready for introduction in the trench at least once per day. The tests shall include:

(A) pH of the slurry,

(B) Unit weight of the slurry,

(C) Filtrate loss of the slurry (once per truckload or lot),

(D) Viscosity of the slurry.

2.04 Slurry in the Trench

Slurry in the trench shall be tested at least once per day. Samples shall be obtained from near the bottom of the trench near the point of trenching and tested for unit weight.

2.0.5 Documentation

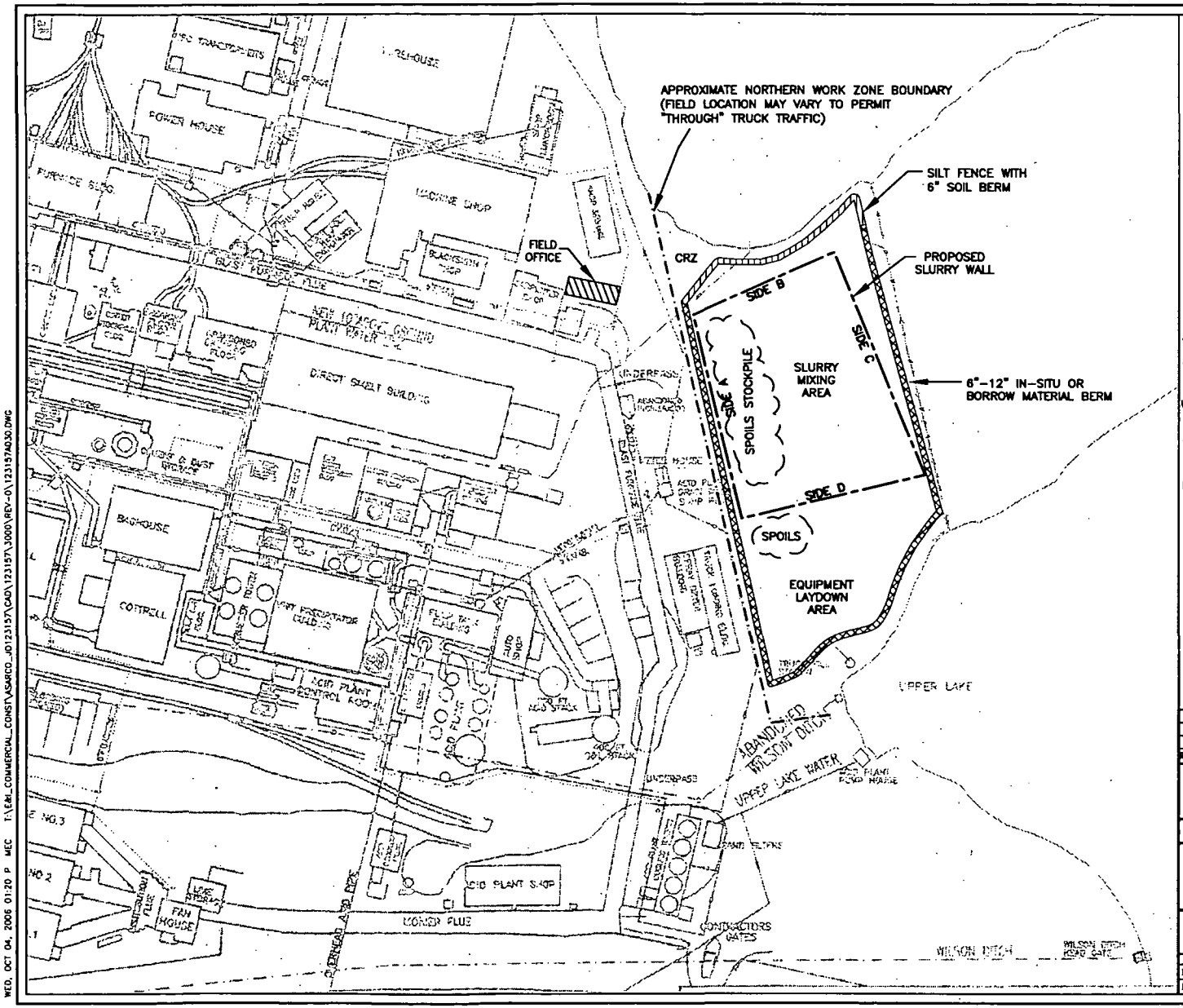
Results of all tests performed in accordance with the Specification will be recorded on forms acceptable to the Contractor's Onsite Quality Control Manager and signed by the Contractor's Slurry Wall Specialist. These forms will be made available to the Contractor's Onsite Quality Control Manager at all times for his inspection. Copies of all forms will be submitted daily to the

Contractor's Onsite Quality Control Manager for his reference.

Table 1: Soil - Bentonite Slurry Trench Quality Control Testing Plan

Property	Requirement (see notes)	Min. Test Frequency	Test Method	Comment
Bentonite Powder				
a. Certification	API 13A	1 per truck or lot	Section 4	Manufactures Cerification
Water for Slurry Mixing				
a. pH	6 to 9	1 per source	API RP 13B-1	May be modified for
b. Hardness	< 500 ppm	1 per source	API RP 13B-1	potable source or if treated
Solids				
Initial Bentonite Slurry				
a. Viscosity	> 40 seconds	2 per shift	API RP 13B-1	
b. Density	> 64 pcf	2 per shift	ASTM D-4380	
c. Filtrate Loss	< 25 cc	1 per truckload	API RP 13B-1	
d. Bentonite content	> 5%	1 per project	Weight-Volume	Demonstrate by proportion
e. pH of Slurry	6.5 to 10	1 per shift	API RP 13B-1	
In-Trench Bentonite Slurry				
a. Unit Weight	64 to 85 pcf	2 per shift	ASTM D-4380	Also > 15 pcf less than SB
b. Viscosity	> 40 seconds	2 per shift	API RP 13B-1	
SB Backfill Material				
a. Slump Cone	3 to 6 inches	1 per shift	ASTM C-143	
b. Gradation	Minimum 10% Fines	1 per shift	ASTM D-1140	Laboratory or Field Test
c. Density	15 pcf > In-trench slurry	1 per shift	ASTM C-138 or API RP 13B-1 D-4380 mod	
d. Bentonite content	> TBD %	1 per shift	Weight-Volume	As per design mix
e. Permeability	< $1x10^{-7}$ cm/sec	1 per 500 cy	ASTM D-5084	Laboratory test

Notes:
1. Some requirements will be changed based on the selected slurry backfill design mix.
2. TBD = to be determined. See note 1.



NOTES

1. CORNERS MAY REQUIRE FIELD ADJUSTMENT TO AVOID SUBSURFACE PIPING SHOWN. BERMS AND SILT FENCE FINAL INSTALLATION LOCATIONS WILL BE DETERMINED IN THE FIELD.
2. FINAL SLURRY WALL ALIGNMENT WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS ESTABLISHED BY ASARCO.
3. SPOILS STOCKPILE(S) WITHIN THE SLURRY WALL ALIGNMENT WILL BE LOCATED IN BERMED, UNLINED AREAS.
4. SPOILS STOCKPILES(S) OUTSIDE THE SLURRY WALL ALIGNMENT WILL BE PLACED IN A CONTAINMENT BERM (E.G., BERMED AREA LINED WITH VISQUEEN).

LEGEND

- PROPOSED SLURRY WALL
- WORK ZONE LIMITS
- SPOIL STOCK PILE
- 6"-12" IN-SITU OR BORROW MATERIAL BERM
- SILT FENCE WITH 6" SOIL BERM
- FIELD OFFICE (TRAILER)

0 50 100
SCALE: 1" = 100'

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	RH	10/03/06

ASARCO, LLC

ASARCO SMELTER FACILITY

FIGURE NUMBER 1

GENERAL PLAN VIEW

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSNR	ERC	09/29/06	CHKD	ERC	09/29/06	123157.3000	0	123157A030
DRAWN	MEC	09/29/06	APPR	RH	09/29/06			

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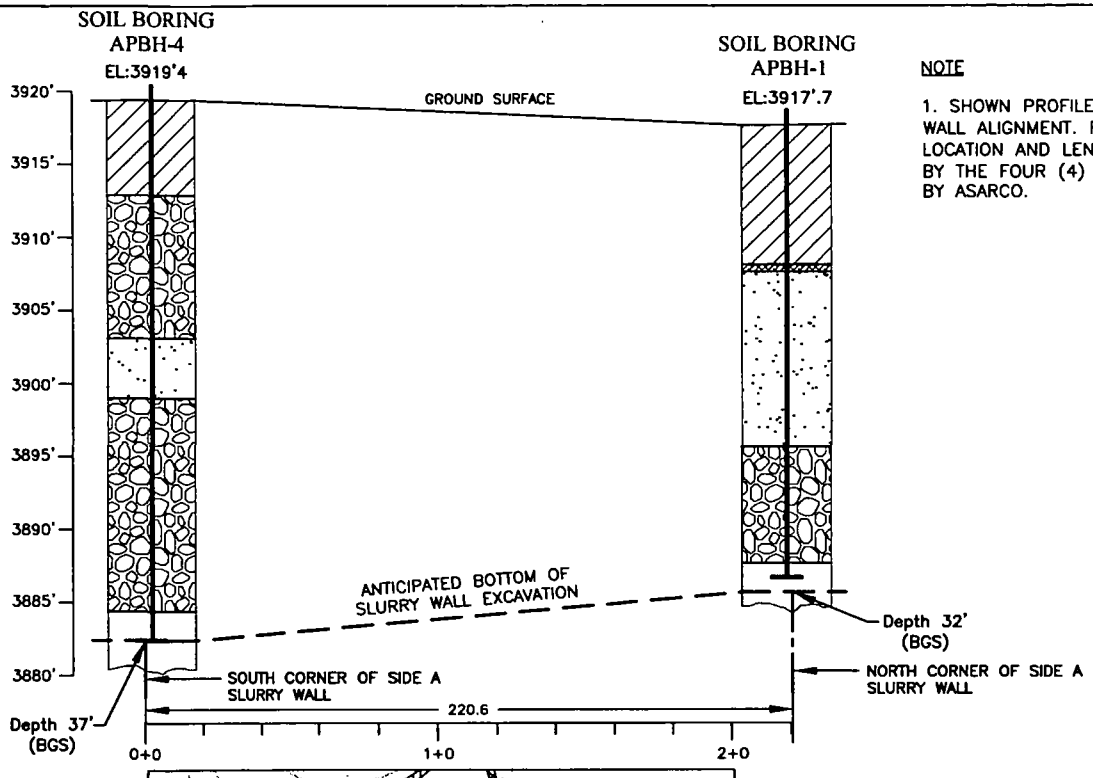
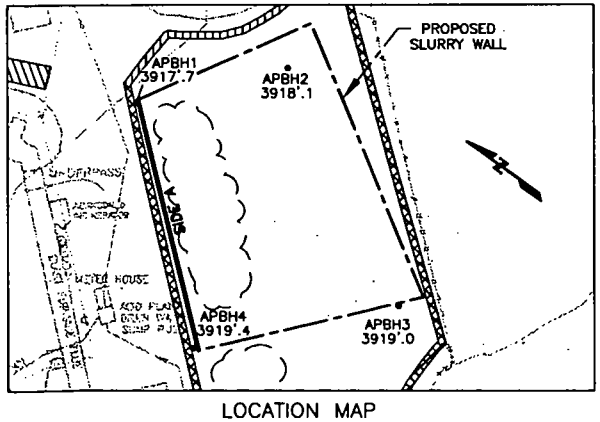


NOTE

1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

LEGEND

- FILL, COMMONLY CONSISTS OF INTERMIXED SAND, SILT, CLAY AND GRAVEL.(ASPHALT, CONCRETE, BRICKS, WOOD.)
- SLAG, UNCONSOLIDATED SAND AND GRAVEL SIZE SLAG.
- SANDY SILT, SANDY/SILTY CLAY, GRAVELY SAND.
- GRAVEL AND COBBLES: HETEROGENEOUS, SAND, SILT OR CLAY MATRIX.
- FINE GRAINED SEDIMENTS CONSISTING OF VOLCANIC ASH-TUFF. GREENISH-YELLOW-WHITE IN COLOR.



LOCATION MAP
SCALE: 1" = 100'

SCALE: 1" = 10'
VERTICAL EXAGGERATION 4X

10
0
40

SCALE: 1" = 40'
HORIZONTAL

REVISION	DESCRIPTION	CHECKED	APPROVER	DATE
0	ISSUED TO ASARCO, LLC	ERC	RH	10/03/06

ASARCO, LLC

ASARCO SMELTER FACILITY

FIGURE NUMBER 2

SLURRY WALL PROFILE SIDE A

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSND	MEC	09/29/06	CHKD	ERC	09/29/06	123157.3000	0	123157A020
DRAWN	MEC	09/29/06	APPR	RH	09/29/06			

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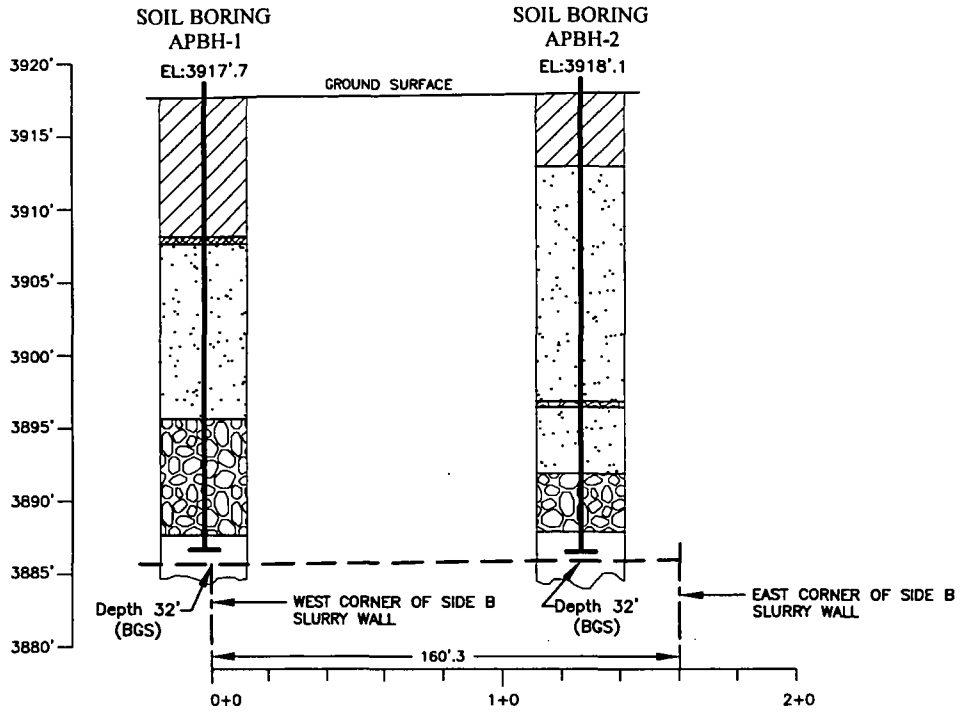


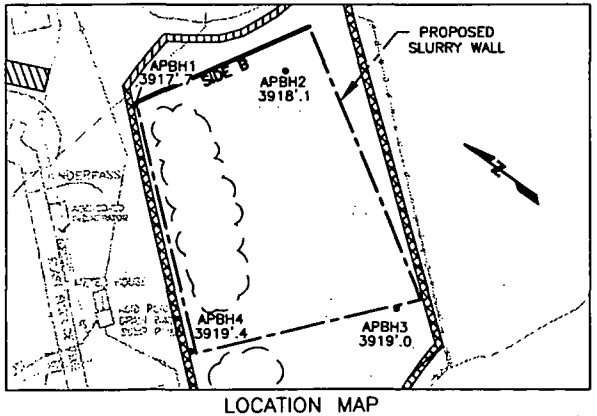
NOTE

1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

2. SOIL BORING APBH-2 IS NOT LOCATED ON SLURRY WALL ALIGNMENT. (PROJECTED TO PROFILE)

LEGEND

- FILL, COMMONLY CONSISTS OF INTERMIXED SAND, SILT, CLAY AND GRAVEL.(ASPHALT, CONCRETE, BRICKS, WOOD.)
- SLAG, UNCONSOLIDATED SAND AND GRAVEL SIZE SLAG.
- SANDY SILT, SANDY/SILTY CLAY, GRAVELY SAND.
- GRAVEL AND COBBLES: HETEROGENEOUS, SAND, SILT OR CLAY MATRIX.
- FINE GRAINED SEDIMENTS CONSISTING OF VOLCANIC ASH-TUFF. GREENISH-YELLOW-WHITE IN COLOR.



LOCATION MAP
SCALE: 1" = 100'

SCALE: 1" = 10'
VERTICAL EXAGGERATION 4X

10
0
40

SCALE: 1" = 40'
HORIZONTAL

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	BH	10/03/06

ASARCO, LLC

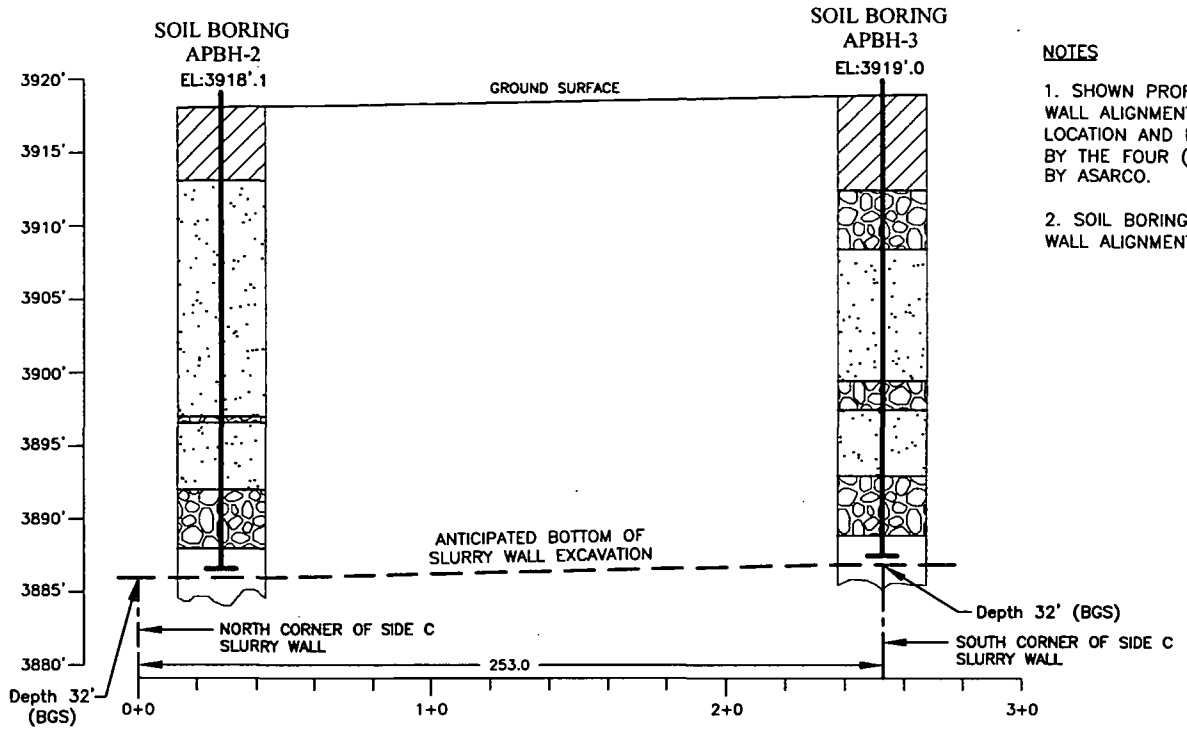
ASARCO SMELTER FACILITY

FIGURE NUMBER 3

SLURRY WALL PROFILE SIDE B

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSND	MCC	09/29/06	CHKD	ERC	09/29/06	123157.3000	0	123157A020
DRAWN	MCC	09/29/06	APPD	BH	09/29/06			



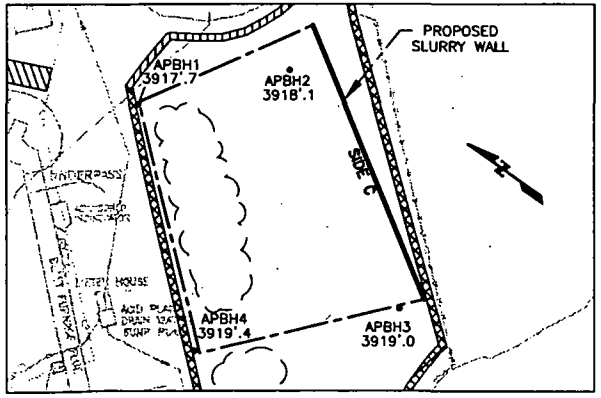
NOTES

1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

2. SOIL BORING APBH-2 IS NOT LOCATED ON SLURRY WALL ALIGNMENT. (PROJECTED TO PROFILE)

LEGEND

- FILL, COMMONLY CONSISTS OF INTERMIXED SAND, SILT, CLAY AND GRAVEL.(ASPHALT, CONCRETE, BRICKS, WOOD.)
- SLAG, UNCONSOLIDATED SAND AND GRAVEL SIZE SLAG.
- SANDY SILT, SANDY/SILTY CLAY, GRAVELY SAND.
- GRAVEL AND COBBLES: HETEROGENEOUS, SAND, SILT OR CLAY MATRIX.
- FINE GRAINED SEDIMENTS CONSISTING OF VOLCANIC ASH-TUFF. GREENISH-YELLOW-WHITE IN COLOR.



LOCATION MAP
SCALE: 1" = 100'

SCALE: 1" = 10'
VERTICAL EXAGGERATION 4X

10
0
40

SCALE: 1" = 40'
HORIZONTAL

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	RH	10/03/06

ASARCO, LLC

ASARCO SMELTER FACILITY

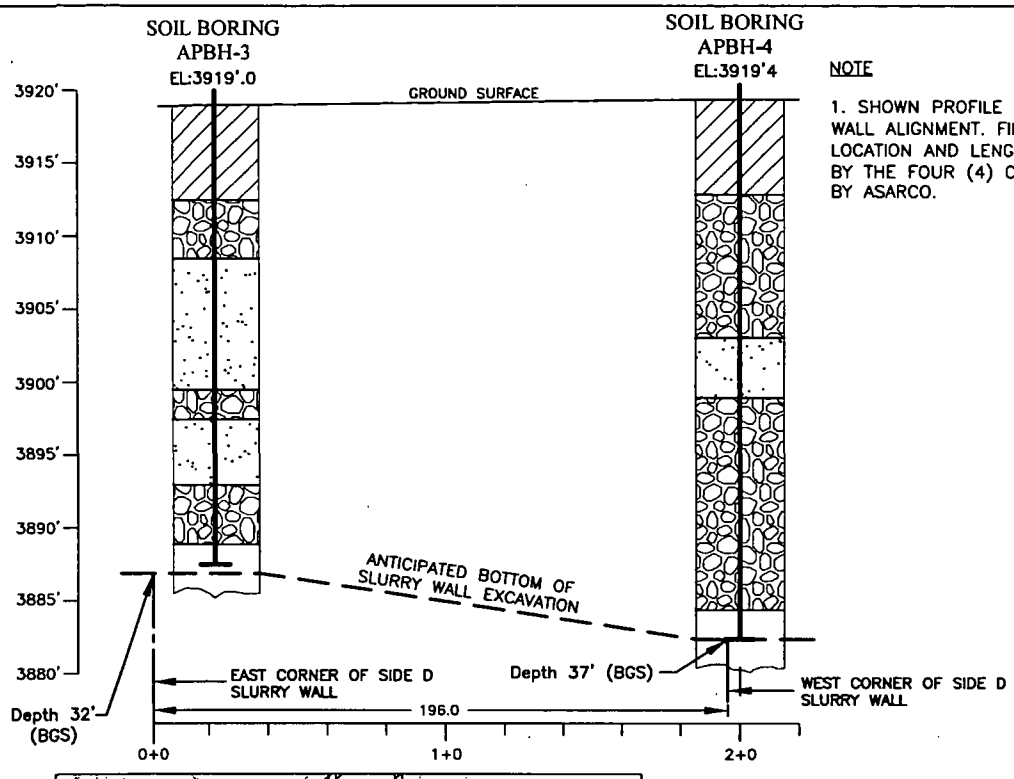
FIGURE NUMBER 4

SLURRY WALL PROFILE SIDE C

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSN'D	MEC	09/29/06	CHK'D	ERC	09/29/06	123157.3000	0	123157A020
DRAWN	MEC	09/29/06	APP'D	RH	09/29/06			

WED, OCT 04, 2006 01:31 P MEC T:\E&I_COMMERCIAL_CONST\ASARCO_J0123157\CAD\123157\3000\REV-0\123157A020.DWG

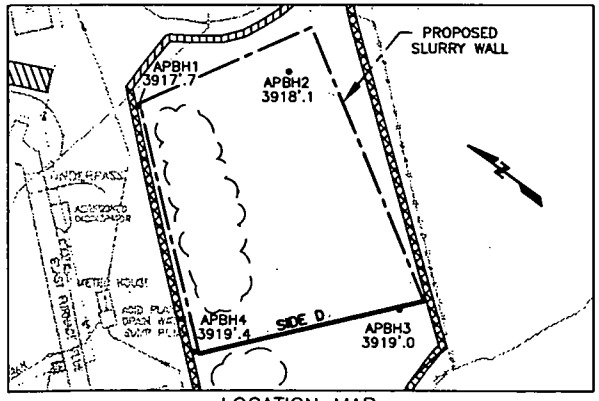


NOTE

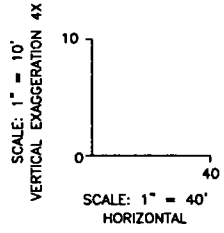
1. SHOWN PROFILE IS BASED ON THE PROPOSED SLURRY WALL ALIGNMENT. FINAL SLURRY WALL ALIGNMENT (I.E., LOCATION AND LENGTH) WILL BE DETERMINED IN THE FIELD BY THE FOUR (4) CORNERS, WHICH WILL BE ESTABLISHED BY ASARCO.

LEGEND

- FILL, COMMONLY CONSISTS OF INTERMIXED SAND, SILT, CLAY AND GRAVEL.(ASPHALT, CONCRETE, BRICKS, WOOD.)
- SLAG, UNCONSOLIDATED SAND AND GRAVEL SIZE SLAG.
- SANDY SILT, SANDY/SILTY CLAY, GRAVELY SAND.
- GRAVEL AND COBBLES: HETEROGENEOUS, SAND, SILT OR CLAY MATRIX.
- FINE GRAINED SEDIMENTS CONSISTING OF VOLCANIC ASH-TUFF. GREENISH-YELLOW-WHITE IN COLOR.



LOCATION MAP
SCALE: 1" = 100'



REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
0	ISSUED TO ASARCO, LLC	ERC	RH	10/10/06

ASARCO, LLC

ASARCO SMELTER FACILITY

FIGURE NUMBER 5

SLURRY WALL PROFILE SIDE D

Shaw Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSGD	MEC	09/29/06	CHKD	ERC	09/29/06	123157.3000	0	123157A020
DRAWN	MEC	09/29/06	APPR	RH	09/29/06			

Quality Control Plan

Former Acid Plant Sediment Drying Area Slurry Wall

ASARCO Smelter Facility East Helena, MT

Shaw E&I Project No.123157

October 2006

Shaw™ Shaw E & I

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED

ABBREVIATIONS AND ACRONYMS

DQCR	Daily Quality Control Report
EPA	U.S. Environmental Protection Agency
FADL	Field Activity Daily Log
MDEQ	Montana Department of Environmental Quality
NCR	Nonconformance Report
PM	Project Manager
QA	quality assurance
QC	quality control
QCM	Quality Control Manager
Shaw	Shaw Environmental & Infrastructure, Inc.
SSHO	Site Safety and Health Officer

QUALITY CONTROL PLAN
FORMER ACID PLANT SEDIMENT DRYING AREA SLURRY WALL

1.0 INTRODUCTION

This Quality Control (QC) Plan, prepared by Shaw Environmental & Infrastructure, Inc. (Shaw), describes quality control procedures for constructing a slurry wall to encompass the former acid plant sediment drying area at the ASARCO Smelter Facility, East Helena, Montana.

1.1 Quality Control Objective

The goal of this QC Plan is to ensure that the required slurry wall construction activities will be completed as stated in the planning documents. Documentation will be prepared and maintained during and after the completion of slurry wall construction activities so that it can be demonstrated that work has been completed and performance requirements of the plans have been met.

1.2 Quality Control Plan

This QC Plan is designed to define the methodology and practices to control the quality of work performed during the construction of the slurry wall. At a minimum, this QC Plan addresses the QC procedures for:

- The organization, responsibilities, and authority for personnel performing QC-related functions;
- The project QC system;
- Inspections and tests;
- Sampling and analyses (if needed);
- Document control/records management;
- Nonconformance's and corrective actions;
- Subcontractor control;
- Change control, and
- Audits and surveillance.

The Quality Control Manager (QCM) or designee will be responsible for implementation of and control of the QC program during site preparation, excavation, debris removal, site closure, and any other work affected by the QC program.

This QC Plan establishes measures for controlling items or activities affecting quality and for verifying compliance with the specified requirements of the contract. Methods used to achieve the goals of the QC Plan include but are not limited to:

- Project planning;
- QC inspection;
- Document/record controls;

- Nonconforming conditions/deficiency corrective actions;
- Completion inspections;
- Subcontractor controls;
- Audits and surveillance;
- Calibration program, and
- Use of standard quality assurance/quality control (QA/QC) forms.

2.0 BACKGROUND

The ASARCO Smelter Facility covers 8.4 square miles near East Helena, Montana. The ASARCO Smelter Facility is located near the intersection of U.S. Highway 12 East and South 1st Street in East Helena. The ASARCO Smelter Facility includes a lead smelter that operated from 1888 until 2001.

The slurry wall will be installed as a continuous wall system using soil-bentonite (SB) slurry to stabilize the trench walls. The intended location of the slurry wall is at the former acid plant sediment drying area located on the south side of the ASARCO Smelter Facility.

The objectives of this project are as follows:

- Design the slurry wall
- Construct the slurry wall at the former acid plant sediment drying area;
- Restore the site; and
- Prepare a final construction report.

3.0 QUALITY CONTROL ORGANIZATION

The project organization chart (Figure 1) depicts the lines of authority as well as the reporting functions of personnel performing quality-related activities on this project. ASARCO will interface with the Environmental Protection Agency (EPA) and Montana Department of Environmental Quality (MDEQ), as necessary.

3.1 Quality Control Organization

The following sections describe the roles, responsibilities, and authorities of key project personnel performing activities that affect project quality.

3.1.1 Project Manager

The Project Manager (PM) will interface directly with ASARCO regarding project execution and accountability and be the primary point of contact for the contract. The PM controls the budget and schedule ensuring that contract requirements are met. The PM will be responsible for managing construction activities, including subcontractors. The PM is responsible for ensuring overall conformance of the work to project and contract requirements and specifications

including technical, cost, and schedule requirements. The PM has the overall responsibility for the success and proper execution of the contract and all delivery orders. The PM will organize the assigned project staff and initiate project planning and implementation activities.

3.1.2 Construction Site Manager

The Construction Site Manager will be responsible for the onsite management and execution of all field project activities in accordance with the Work Plan and federal, state, and local laws and regulations. The Construction Site Manager will function as the primary point of contact for onsite ASARCO, field personnel, and subcontractors. The Construction Site Manager will advise the PM of technical progress, expenditures, project needs, potential problems, and recommended solutions.

3.1.3 Quality Control Manager

The QCM will report directly to the PM on all matters within the scope of the project QC program. The QCM is responsible for the overall management of the QC program on site and off site, including field installation activities and consulting engineering activities for the project.

Duties of the QCM include but are not limited to the following:

- Implementing the project QC Plan;
- Initiating or recommending corrective actions;
- Verifying the implementation of corrective actions;
- Continuously evaluating the effectiveness of the project QC Plan;
- Notifying the PM of conditions adverse to quality that cannot be resolved at the project level;
- Monitoring operation activities for compliance with contract requirements;
- Monitoring laboratory testing activities;
- Identifying and reporting nonconforming items, conditions, or activities;
- Monitoring onsite subcontractors;
- Preparing QC reports if required by the contract;
- Performing and documenting installation inspection activities, and
- Performing or monitoring sampling activities.

3.1.4 Subcontractors

When other companies and/or subcontractors are involved in performing activities governed by the requirements of the QC Plan, the responsibility and authority of such organizations will be clearly established and documented. Although Shaw may delegate the work of establishing and executing certain portions of the QC Plan, Shaw will retain responsibility for fulfilling the QC program.

3.1.5 Site-Specific QA/QC Control Training

The QCM (or designee) is responsible for providing basic training of all project personnel performing quality-related activities. The training will include a review of the project QC Plan, work plans, regulatory requirements, and other project-specific documents necessary for personnel to perform project work activities properly.

3.1.6 Changes of QA/QC Personnel

Shaw will strive to maintain continuity of QA/QC personnel on the project. In the event that personnel changes become necessary, ASARCO will be notified and approval received for any proposed change.

4.0 QC INSPECTIONS

QC inspections will be conducted to ensure that project tasks are performed per the Work Plan. A final inspection will be formally scheduled and completed for the entire project. Each type of anticipated inspection is discussed in the following paragraphs. Completed inspection forms and a log will be maintained in the site QC files and will be available for review at any time.

4.1 Preparatory Inspections

Preparatory meetings/inspections will be performed before the execution of field work. The preparatory inspection meeting will be attended by the Shaw Construction Site Manager (who will also fulfill the roles of the Site Safety and Health Officer [SSHO] and the CQM) and subcontractors. The preparatory/inspection meeting will include:

- Reviewing contract plans;
- Reviewing pertinent contract specifications and drawings;
- Reviewing materials and equipment documentation for required tests, submittals, and approvals;
- Reviewing required control inspections and test requirements;
- Establishing that the preliminary work required to begin the task is complete and conforms to approved drawings and submittal data;
- Establishing that the required materials and equipment for commencement of the work are on hand or available for use on the task;
- Confirming that materials and equipment conform to the specifications and that all equipment is properly calibrated and in proper working condition;
- Discussing procedures for performing the work; and
- Reviewing the appropriate activity hazard analysis.

Personnel performing work activities affected by a preparatory inspection will be instructed as to how to complete the task so that their workmanship is in compliance with QC requirements.

4.2 Initial and Follow Up Inspections

Additional inspections will be conducted at the start of the project and on a continuous basis to ensure continuing compliance with contract requirements. The frequency of the inspections will depend upon the extent of work being performed. The inspection will be conducted to evaluate the following criteria:

- Verification of preliminary work;
- Compliance with the specifications, drawings, submittals, and other contract requirements;
- Compliance with the Site-Specific Health and Safety Plan (Shaw, 2006);
- Acceptable quality of workmanship, and
- Resolution of any differences.

4.3 Equipment Inspections

Equipment will be inspected and calibrated according to manufacturer's requirements before field use. Inspection of heavy installation equipment will be recorded daily. These forms will be attached to the Shaw Field Activity Daily Log (FADL) and submitted to project management on a daily basis. All equipment inspections and calibrations will be conducted by personnel with specific training and experience in the operation of that equipment.

4.4 Installation Contingency Procedures

Changes to the Work Plan and/or specifications may be required during installation to address unforeseen situations encountered in the field. In the event that a change to the approved plans is necessary, the Shaw Construction Site Manager will stop work and notify the PM of the change. The PM will immediately provide formal oral notification to ASARCO, MDEQ and the EPA about the change. Upon approval of the change by ASARCO, MDEQ and the EPA, installation activities will continue.

In the event that an emergency condition such as a fire or earthwork failure arises, notifications will initially be completed orally via telephone and documented later. Emergency notifications to all concerned parties may be made simultaneously, if necessary.

4.5 Substantially Complete and Final Inspections

The Shaw Construction Site Manager or the designated Shaw representative will conduct substantially complete and final inspections to verify that the work performed meets the requirements of plans, specifications, quality, workmanship, and completeness. The substantially complete and final inspection will be attended by representatives of ASARCO and subcontractors (if needed). Representatives from EPA and MDEQ will also be invited to attend all inspections.

A substantially complete inspection will be conducted at the completion of all work to verify compliance with the contract plans and requirements. During the substantially complete inspection, a punch list of items not conforming to the specified requirements, including incomplete project items, will be developed, if required.

Upon completion/correction of the punch list items, a final inspection will be conducted to verify that completed work conforms to the contract requirements. The notice of a final inspection will include assurance that all punch list items previously identified will be completed by the date scheduled for the final inspection. ASARCO will sign-off on the final inspection to concur that the site was returned to contractually required conditions.

4.6 Safety Inspections

The SSHO will perform daily safety inspections and daily safety meetings throughout the project. The inspections and meetings will be reported on the Shaw FADL. The inspection and meeting attendance form will be maintained in the project files. Details of the safety inspections can be found in the Site-Specific Health and Safety Plan (Shaw, 2006).

4.7 Field Inspections

Field inspections are primarily visual examinations, but may include measurements of materials and equipment being used, techniques employed, and the final products. These inspections will confirm that a specific guideline, specification, or procedure for the activity has been successfully completed. These inspections will be performed either during remediation and/or installation work activities or shortly after completion of the work by the QCM. The results will be documented in the Shaw FADL.

4.8 Field Tests

Field tests are tests or analyses made in connection with site activities. Field tests will be performed primarily on the slurry during the preparation of the slurry, monitoring of the slurry, and degradation of the slurry. Field tests will be performed by the Subcontractor, Geo-Solutions, Inc. The results of the field tests will be documented daily on forms provided by Geo-Solutions (see Attachment A).

4.9 Surveys

Surveys include the establishment of horizontal and/or vertical grade control for installation, establishment of an elevation benchmark, reference/location surveys for structures, and topography, as appropriate and reviewed by the QCM.

4.10 Review of Manufacturers' Certificates of Compliance

Certificates of Compliance will be obtained from suppliers for selected materials. The certificates will be reviewed/approved by the QCM prior to material delivery. Certificates will include a statement that the material meets all the specification requirements, and supporting test results shall also be provided.

4.11 Inspection Checklists

Inspection checklists will be required for all definable features of work and will document inspection results. The checklists will be maintained by the QCM and be attached to the Shaw FADL.

5.0 DOCUMENT CONTROL

This QC Plan establishes the document control system that provides measures for controlling the issuance, distribution, storage, and maintenance of documents relating to quality, including those of subcontractors and other vendors.

5.1 Field Activity Daily Log

The Shaw FADL will be completed to document all project activities. The report will cover both conforming and nonconforming work and, where applicable, will include a statement of certification that all materials, supplies, and work comply with the contract requirements. The Shaw FADL will include:

- Location and type of work;
- Type and number of control activities;
- Results of inspections and tests;
- Types of defects/causes for rejection, if any;
- Corrective actions proposed/taken, if any;
- Trades/personnel working – type and number;
- Weather conditions;
- Delays and their causes, if any;
- Verbal instructions;
- Samples collected;
- Field analyses performed, including results;
- Calibration procedures and readings;
- Health and safety activities;
- Equipment used;
- Equipment daily check list;
- Nonconformance reports, deficiency reports, and records of statement of work clarifications;
- Remarks, and
- Certifications.

An example of the Shaw FADL form is included in Attachment A of this plan. Other QC forms may be used as required by the contract. Additional documentation (e.g., test reports, subcontractor daily reports, and other pertinent documentation) may be included as attachments to the Shaw FADL.

5.2 Project Records

QC records will be prepared to furnish documented evidence that project activities, including laboratory analyses, fulfill the scope of work and are in compliance with the requirements of the contract. Records will be maintained and stored at the project site. Upon completion of the

project, the project records will be kept at the Shaw office in Portland, Oregon. Records will be readily retrievable for review and audit purposes by Shaw or ASARCO. The records will be controlled in order to avoid the possibility of their loss or damage. The records will be consistent with the applicable sections of the contract specifications and may include:

- Inspection reports;
- Monitoring and surveillance activities;
- Personnel qualifications;
- Corrective actions;
- Training records, and
- Other specified documents.

5.3 Inspection Documentation

The QCM is responsible for the maintenance of the inspection records. Inspection records will be legible and will clearly provide all information necessary to verify that the items or activities inspected conform to the specified requirements. In the case of nonconforming conditions, inspection records will provide evidence that the conditions were brought into conformance or otherwise accepted by ASARCO.

6.0 NOTIFICATION OF NONCONFORMANCES

This section describes the procedures for controlling items that do not conform to specified design requirements by tracking them from identification through acceptable corrective action. All personnel are responsible for identifying deficiencies and notifying the QCM.

6.1 Identifying Deficiencies

The QCM will be notified of all deficiencies identified during the course of site activities to ensure that each deficiency is documented, reported, and tracked, that corrective actions are taken, and that follow-up verification is conducted.

The QCM will include the identified deficiencies in the Shaw FADL, noting the item found to be deficient, date, time, location, the person who identified the deficiency, and the status of the item to which the deficiency applies (installed, awaiting installation, deficiency identified upon receipt, item previously accepted but in storage, etc.). The QMC will also include what action is being performed to correct the deficiency.

6.2 Punch Lists

Substantially complete inspections conducted by the QCM typically result in the development of a punch list of items that do not conform to approved plans. During the course of each substantially complete inspection, the QCM will document nonconforming items in a punch list that will serve as input to the QCM database for items requiring corrective action. The database will serve as the tracking system for the follow up of open items and will identify when they are completed.

The QCM will monitor the punch list corrective action database on a daily basis until all corrective actions have been completed and the punch list is closed out. A printout of database open items will be included with and attached to each day's Shaw FADL.

6.3 Notification

ASARCO will be notified of the identification and progress toward resolution of nonconforming items/conditions through the reporting requirements stated in the project procedures and/or plans or through attendance at coordination meetings.

7.0 TESTING

This section describes the controls to be implemented for the performance of tests required to verify the acceptability of the slurry wall construction activities. The testing will include onsite field tests for the preparation of the slurry mix.

7.1 Slurry

Onsite field tests will be conducted to verify that the materials (e.g., water) and slurry mixture meets the requirements. Table 1 presents the quality control testing plan (property, requirement, test methods, and frequency). Results will be documented on forms (i.e., Geo-Solutions' Daily Quality Control Reports [DQCR]), which are included in Attachment A. The slurry will be adjusted accordingly if the mixture does not meet the requirements for the three phases.

7.2 Site Soil and Water Sampling

Soil and groundwater sampling activities will not be conducted during the construction of the slurry wall.

7.3 Air Monitoring

Air monitoring will be conducted to monitor dust emissions and the effectiveness of dust control techniques during soil excavation and placement. The SSHO will select the air monitoring location(s) based on anticipated work activities, site contaminants, wind direction, and anticipated traffic flow. Further information regarding the air monitoring program is presented in the Site-Specific Health and Safety Plan (Shaw, 2006).

8.0 FIELD QUALITY CONTROL

The field control component of the QC Plan includes:

- Procedures for documenting and justifying any field actions contrary to the QC Plan;
- Documentation of all pre-field activities such as equipment checkout, calibrations, and manufacturer inspections;

- Documentation of field inspection activities during the project; and
- Documentation of field measurement QC data.

8.1 Field Changes to Quality Control Plan

Changes to the QC Plan procedures, testing requirements, or personnel may be required to adjust for unforeseen circumstances. Changes may be required in the event that the given procedures do not provide adequate control, or may be proactively initiated by Shaw to ensure that QC objectives are met.

Should modifications to this QC Plan become necessary or desirable; the Shaw PM will notify ASARCO in writing. The notification will include a description of the proposed change, the reason(s) for requesting the change, and the date upon which the change needs to become effective, along with other pertinent information.

8.2 Pre-Field Activities

Pre-field activities include calibrating equipment, performing preparation inspections, obtaining field permits, and obtaining a copy of the manufacturer inspection documents for materials to be incorporated into the project.

8.2.1 Field Equipment Calibrations and Inspections

Equipment will be inspected and calibrated according to manufacturer's requirements before field use. Inspection of heavy installation equipment will be recorded daily on the Safety Inspection of Heavy Equipment form (see Site-Specific Health and Safety Plan). Calibration of field testing equipment will be recorded on equipment calibration forms. All equipment inspections and calibrations will be conducted by personnel with specific training and experience in the operation of that equipment. These forms will be attached to the Shaw FADL and submitted on a daily basis.

8.2.2 Field Permits

Shaw will coordinate through ASARCO to obtain any required permits, before beginning construction activities.

8.3 Field Measurement Quality Control

Field measurements will generate substantial quantities of data. Field measurement data results for the slurry will be included on Geo-Solution's DQCR (see Attachment A). Copies of completed Geo-Solutions DQCRs will be turned in the Shaw QCM as soon as the results are available.

8.4 Inspection of Field Activities

Field activities will be inspected on a daily basis, and more frequently as required by Shaw staff. Shaw will make daily inspections of all work in progress, recording all deficiencies in the field

log along with a notation of the corrective action taken. All other inspection activities will also be reported in the field log.

8.5 Subcontractor Direction

Activities of subcontractors will be under the direction of Shaw Construction Site Manager. Inspections of all subcontractor work, including inspections, will be conducted by the QCM.

9.0 SUBCONTRACTOR CONTROL

All subcontractors performing work for the project are responsible for conformance to the quality requirements of their respective subcontract. Subcontractors include organizations supplying quality-related items or services to the project. The overall responsibility for conformance to the quality requirements for the subcontracted items and services is retained by Shaw.

The requirements for personnel qualifications, technical performance levels, QC procedures, acceptability levels, and documentation will be included as a part of the subcontract documents.

The QCM is responsible for the implementation of inspections, document reviews, audits, and other QC activities used to monitor the subcontractor's compliance with the contract. These activities will be documented on checklists, field logs, or other forms appropriate to the function performed.

For field operations, the Shaw staff will provide QC checks before, during, and after the completion of the subcontractor's activities. The QC checks will include preparatory, initial, follow-up, and final inspections to determine if the subcontractor is in compliance with the QC measures set forth by the contract and the applicable subcontract responsibilities including:

- Meeting quality requirements;
- Generating, controlling, and maintaining required documentation;
- Performing and documenting required inspections and tests;
- Identifying, reporting, and correcting nonconforming conditions, and
- Turnover of documentation to Shaw.

9.1 Subcontractor QA/QC Responsibilities

Subcontractors performing work will be monitored by the Shaw staff to verify conformance to the contract and subcontract quality requirements. The monitoring activities will include inspections. All monitoring activities will be documented on the appropriate form or included in the Shaw FADL. Subcontractors will be required to provide documentation consistent with project requirements.

9.2 Subcontractor Nonconformance

Work performed by subcontractors that does not comply with the specified requirements will be identified, reported, corrected, and tracked in accordance with this QC Plan.

9.2.1 Notification of Nonconformance

Notification of subcontractor noncompliance will be accomplished via the Nonconformance Report (NCR), with copies kept in the QC files.

9.2.2 Corrective Actions

Corrective actions by subcontractors will be monitored by the QCM or designee to verify that the subcontractor's performance meets the required specifications.

10.0 REFERENCES

Shaw. 2006. *Site-Specific Health & Safety Plan for the Former Acid Plant Sediment Drying Area Slurry Wall Construction, ASARCO Smelter Facility, East Helena, MT.* October 2006.

FIGURE 1
PROJECT ORGANIZATIONAL CHART

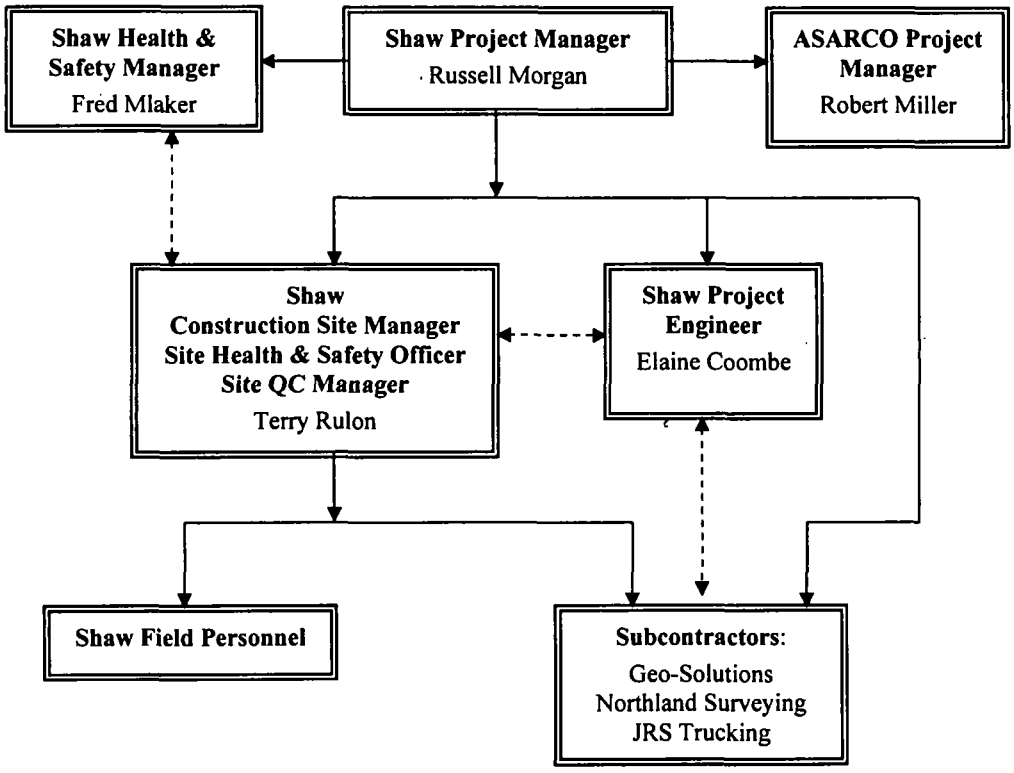


TABLE 1

SOIL - BENTONITE SLURRY TRENCH QUALITY CONTROL TESTING PLAN

Property	Min. Test Frequency	Test Method	Comment
Bentonite Powder			
a. Certification	1 per truck or lot	Section 4	Manufactures Cerification
Water for Slurry Mixing			
a. pH	1 per source	API RP 13B-1	May be modified for
b. Hardness	1 per source	API RP 13B-1	potable source or if treated
Solids			
Initial Bentonite Slurry			
a. Viscosity	2 per shift	API RP 13B-1	
b. Density	2 per shift	ASTM D-4380	
c. Filtrate Loss	1 per truckload	API RP 13B-1	
d. Bentonite content	1 per project	Weight-Volume	Demonstrate by proportion
e. pH of Slurry	1 per shift	API RP 13B-1	
In-Trench Bentonite Slurry			
a. Unit Weight	2 per shift	ASTM D-4380	Also > 15 pcf less than SB
b. Viscosity	2 per shift	API RP 13B-1	
SB Backfill Material			
a. Slump Cone	1 per shift	ASTM C-143	
b. Gradation	1 per shift	ASTM D-1140	Laboratory or Field Test
c. Density	1 per shift	ASTM C-138 or API RP 13B-1 D-4380 mod	
d. Bentonite content	1 per shift	Weight-Volume	As per design mix
e. Permeability	1 per 500 cy	ASTM D-5084	Laboratory test

ATTACHMENT A

DAILY FORMS

SHAW

FIELD DAILY ACTIVITY LOG

Shaw™
Shaw E & I, Inc.

FIELD ACTIVITY DAILY LOG

DAILY LOG				
	DATE			
	NO.			
	SHEET		OF	

PROJECT NAME: **Slurry Wall at the Acid Plant Sediment Drying Area**	CONTRACT #: **Shaw E&I Project No.123157**
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS: WEATHER CONDITIONS CHANGES OF PLANS AND SPECIFICATIONS/SPECIAL ORDERS IMPORTANT DECISIONS VISITORS ON SITE IMPORTANT PHONE CALLS	
SIGNATURE:	DATE:

Shaw™
Shaw E & I, Inc.

FIELD ACTIVITY DAILY LOG CONTINUATION SHEET

DAILY LOG				
	DATE			
	NO.			
	SHEET	2	OF	2

PROJECT NAME: **Slurry Wall at the Acid Plant Sediment Drying Area**	CONTRACT #: **Shaw E&I Project No.123157**

DESCRIPTION OF INSPECTIONS

Preparatory Inspections:

Initial Inspections:

Follow-up Inspections:

Completion Inspections:

General Site Inspection:

SIGNATURE:	DATE:

GEO- SOLUTIONS

DAILY QUALITY CONTROL REPORT

PROJECT NAME
PROJECT NAME
PROJECT LOCATION

BENTONITE CALCULATION

SOIL-BENTONITE CUTOFF WALL **EXAMPLE**

DAILY QC RESULTS TECHNICAL SPECIFICATION: _____

DATE: _____ SHIFT NO. INSPECTOR: _____

Geo-Solutions

CALCULATIONS FOR THE ADDITION OF DRY BENTONITE TO TRENCH BACKFILL

DATA AS OF END SHIFT

NUMBER OF BULK BAGS MIXED AND PLACED TO DATE		320	
AVERAGE WEIGHT PER BAG		2800	LBS
TOTAL LBS. OF BENTONITE MIXED AND PLACED	X	896000	LBS.
TOTAL CUBIC FEET OF BACKFILL PLACED TO DATE		453141	CF
DRY UNIT WEIGHT OF BACKFILL (PCF)	X	100	PCF
TOTAL DRY WEIGHT OF BACKFILL PLACED		45314100	LBS.
PERCENT BENTONITE ADDED TO DRY WEIGHT OF THE BACKFILL		1.98%	
NUMBER OF BULK BAGS MIXED AND PLACED THIS DATE		22	
AVERAGE WEIGHT PER BAG		2800	LBS
TOTAL LBS. OF BENTONITE MIXED AND PLACED	X	61600	LBS.
TOTAL CUBIC FEET OF BACKFILL PLACED THIS DATE		25245	CF
DRY UNIT WEIGHT OF BACKFILL (PCF)	X	100	PCF
TOTAL DRY WEIGHT OF BACKFILL PLACED		2524500	LBS.
PERCENT BENTONITE ADDED TO DRY WEIGHT OF THE BACKFILL		2.44%	

COMMENTS:

SIGNED: _____ SIGNED: _____

Contractor's QC Supervisor Owner's Representative

SLURRY EXCAVATION

PROJECT NAME _____
PROJECT NAME _____
PROJECT LOCATION _____

SOIL-BENTONITE CUTOFF WALL

DAILY QC RESULTS TECHNICAL SPECIFICATION: _____

DATE: _____ SHIFT NO. _____ INSPECTOR: _____

Geo-Solutions

KEY: _____ BUCKET WIDTH: _____ VERTICALITY: _____

MEASURE EXCAVATION PRIOR TO BACKFILLING (Every 10 lf)

DATE	STATION NO.	DEPTH TO TOP OF KEY FORMATION Ft.	DEPTH IN KEY Ft.	FINAL RECORD DEPTH FROM PLATFORM Ft.	PANEL LENGTH Ft.	PANEL AREA EXCAVATED SF	COMMENTS
						SQ FT TODAY	
						SQ FT TODATE	

COMMENTS: _____

SIGNED: _____ SIGNED: _____

Contractor's QC Supervisor Owner's Representative

PROJECT NAME _____ SOIL-BENTONITE

PROJECT NAME _____

PROJECT LOCATION _____

SOIL-BENTONITE CUTOFF WALL

DAILY QC RESULTS TECHNICAL SPECIFICATION: _____

DATE: _____ SHIFT NO. _____ INSPECTOR: _____

TEST SOIL-BENTONITE BACKFILL (Once per shift) (Sample for laboratory test – 3 per project)

SLUMP

Time: [ ] Station: [ ] Result: [ ]

DENSITY

Time: [ ] Station: [ ] Result: [ ]

GRADATION

Time: [ ] Station: [ ] Result: [ ]

LABORATORY PERMEABILITY

Time: [ ] Station: [ ] Sample No. [ ]

Sample Transported to Laboratory via [ ]

[ ]

[ ]

COMMENTS:

_____

_____

_____

SIGNED: _____

SIGNED: _____

Contractor's QC Supervisor

Owner's Representative

PROJECT NAME
PROJECT NAME
PROJECT LOCATION

BENTONITE SLURRY REPORT

SB SLURRY WALL

DAILY QC RESULTS

DATE: _____ SPECIFICATION: _____ INSPECTOR: _____

Geo-Solutions

FRESH BENTONITE SLURRY:

VISCOSITY- MINIMUM 40 SECONDS

TIME: _____ RESULT: _____ SECONDS

FILTRATE LOSS- <25 CC IN 30 MINUTES

TIME: _____ RESULT: _____ CC

pH > 7 UNITS

TIME: _____ RESULT: _____ UNITS

DENSITY- MINIMUM 64 PCF

TIME: _____ RESULT: _____ PCF

TIME: _____ RESULT: _____ PCF

TRENCH BENTONITE SLURRY:

DENSITY- 64 to 85 PCF

TIME: _____ DEPTH: _____ RESULT: _____ PCF

PROJECT NAME
PROJECT NAME
PROJECT LOCATION

BENTONITE SLURRY REPORT

SB SLURRY WALL

FILTRATE LOSS- <25 CC IN 30 MINUTES

TIME: RESULT: CC

VISCOSITY- MINIMUM 40 SECONDS

TIME: RESULT: SECONDS

pH > 7 UNITS

TIME: RESULT: UNITS

MIXING WATER

6 < pH < 8

TIME: RESULT: UNITS

HARDNESS < 250 ppm (as indicated)

TIME: RESULT: PPM

TDS < 750 ppm (as indicated)

TIME: RESULT: PPM

COMMENTS:

PROJECT NAME
PROJECT NAME
PROJECT LOCATION

BENTONITE SLURRY REPORT

SB SLURRY WALL

SIGNED: _____
Contractor's QC Supervisor

SIGNED: _____
Owner's Representative